Engineering Record

A Weekly Journal Devoted to Civil Engineering and Contracting

PUBLISHED BY MC GRAW-HILL PUBLISHING COMPANY, INC.

Volume 75 NEW YORK, SATURDAY, MARCH 24, 1917 Number 12

Eight-Hour Law

THE "eight-hour law" is constitutional, and the right of Congress to regulate wages has been established —established, it is true, by the narrowest possible majority in the Supreme Court, five to four. Casting aside all of the constitutional and legal lines of argument along which this controversy may be pursued, and looking at it from the standpoint of common sense and recent tendencies, it was inevitable that eventually it would be decided that Congress had the power to regulate wages on interstate carriers. By a long series of enactments the government has come to exercise most complete control not only over every item of service, but also over rates. It sets the income that shall be allowed and the service that shall be rendered for that income. Outgo has been affected by the service requirements placed on the carriers. To us it seems, stripped of the legal controversies, but a short step to curtail that outgo still further by setting the wages of the men. Moreover, if the government shall say what the railroads shall earn, how can it refuse to fix the wages that the men shall have, when those men are so organized that they can enforce their demands against the railroads or tie up the country? Under the circumstances no other ground than wage control seems tenable, and in saying that we are fully cognizant that our positiveness is not justified by the narrowness of the majority in the Supreme Court supporting the measure. It need hardly be said, of course, that we heartily disapprove of the manner in which the wage increase was secured—by "holding up" Congress, and, without investigation as to their ability to pay, laying an additional financial burden on the railroads. It is unthinkable, of course, that Congress will permanently exercise its wage-fixing power. Undoubtedly it will delegate authority to the Interstate Commerce Commission, and we shall expect from that body a careful study of the finances of the carriers before imposing new burdens. Finally, the right to fix wages having been sustained, but one more step remains—to require compulsory arbitration, or at least a statute preventing a strike while a controversy is under investigation. That the right to compel arbitration is bound up with that of fixing hours and wages is plainly stated by the chief justice in these words: "Rights are necessarily subject to limitation when employment is accepted in a business charged with a public interest." This part of the decision is not welcomed by the brotherhoods, but they illogically have sought the rewards but hoped to escape the responsibilities.

The Engineer Salesman

FOR YEARS manufacturers of electrical and mechanical equipment have put young engineering graduates through their factories and organizations in order to train them for their sales forces. The plan has proved very successful and is the established means of recruiting sales forces in high-class organizations having a technical product. It is interesting to note that our foreign trade expansion is forcing organizations which desire to sell technical products abroad to adopt similar training plans. In an article in the current issue of *The Americas*, S. T. Henry describes the methods that the machinery-selling organizations of the American International Corporation propose to apply in their work of extending the use of American machinery in foreign lands. Not finding available a force of men familiar both with American machinery and with foreign languages and trade customs, they are taking young engineers, putting them through the shops where the equipment to be sold is fabricated, and then, after a further course in the New York office of the company, sending them abroad. The wisdom of this policy is so patent that it need not be argued here. It may be pointed out, however, that the work of these young men when they reach their foreign posts is not merely to effect sales, but to show foreign engineers, constructors and manufacturers how American equipment can be used to advantage. This educational feature of their work will be particularly emphasized in connection with American construction machinery, which has very limited application abroad at the present time, and the tremendous possibilities of which in cost-reduction are not even remotely sensed. Since the war began this journal has repeatedly referred to the enlarged field which our expanding foreign commerce and investments are creating for the American engineer. To the fields already pointed out is now added the very attractive field of engineering salesmanship.

Engineering Co-operation

CO-OPERATION between engineering societies has been the subject of frequent discussion in recent years. The results to date may be somewhat disappointing, considering the amount of thought devoted to the subject. Yet most engineers, we believe, will concede that the discussions have helped us to clarify our ideas and to learn, at least, some of the things not to do. Eventually, and very shortly, we hope, machinery will be perfected by which all of the local engineering societies will work together. In national bodies the progress has been very considerable and discussions are under way which should result in a wider participation by them in affairs of a public character. For a basis for discussion on this subject the reader is referred to the report of a committee prepared for the Third Annual Conference on Engineering Co-operation to be held in Chicago next week, printed elsewhere in this issue. Space does not permit of discussion here of the various proposals made. Particularly are those to be commended which refer to the conduct of local organizations. Not enough attention has been given in a broad way toward strengthening the local societies, and in the last analysis these are the bodies which will have direct contact with the public. The larger organizations can speak on national topics, can guide and inspire the local bodies. They are to be compared, however, to the headquarters of an army, the local societies being on the firing line. Efficiency is needed in both places. So far, the headquarters organization has made the greater progress. Not until the fighting units are equally well taken care of, however, can the profession exercise its greatest influence.

State Control of Bridge Construction

IN the closing pages of the "Bridge Manual" recently issued by the Oregon State Highway Commission, prepared under the direction of John H. Lewis, state engineer, there is given a summary of the present situation in regard to bridge legislation. It is stated that only four states have no organized highway commission—Georgia, South Carolina, Texas and Indiana. In fifteen states plans and specifications for strictly county bridges are prepared by the state on request, while in five states plans and specifications prepared by the state are obligatory on the counties. In six states plans may be submitted for approval at the option of the counties and in eight states they must be submitted to the state for approval. In four states these plans and specifications are drawn up by the counties, following standards prescribed by the state, and in seven states the counties have absolute control. In Illinois the loading of county bridges is prescribed by law, and the Minnesota law demands the annual inspection of all bridges by the highway commission.

The object to be attained by the publication of bridge manuals in which best standard practice is illustrated for the purpose of co-ordinating and unifying the design and construction of bridges and culverts throughout the state is certainly to be commended. It is evident that the extent to which state control and supervision should be carried is widely different for different states. Central control, if competent, should lead to economy in many ways, the most important of which lies in reduced contract prices by bridge companies, due to the fact that they know exactly what they have to furnish and are not forced to make many alternate designs, which heretofore have been a prolific source of waste in time and labor in estimating departments. Not only is greater economy attained, but the standardization of plans architecturally and structurally can be made to anticipate future traffic conditions in a reasonable and conservative way.

In one respect the practice of state control has not yet been carried far enough. By furnishing free plans and specifications, or approving estimates and designs, the state commission is responsible only for the paper details—the actual construction in the field may be wholly unsatisfactory because of the failure of the contractor to do his work properly. Supervision by the state should be exercised over the actual construction work, either by inspectors furnished by the commission, by instructions issued to county inspectors or direct control over such inspectors. Actual cases of friction between county and state have occurred because of failure in execution of standard state plans. Complete control and standardization are possible only when measures are taken to have actual construction done in accordance with the plans and specifications.

Engineering Estimates and Research

ARE engineers too optimistic in designing their work and in their estimates of time and cost? This was a question discussed by Sir Maurice Fitzmaurice in his installation address as president of the Institution of Civil Engineers. The address is well worth reading for its sound and thoughtful discussion of the obstacles to success in engineering. Answering the question, he says that engineers must plead guilty to the charge—sometimes at least—and then he explains how and why. His chief points are that engineering is not an exact science; that allowances must be made for lack of information and for contingencies; that the client considers the allowances of the careful engineer excessive, and insists that the unknown factors be regarded favorably rather than as having an even chance of happening, or not happening; and that the engineer reluctantly finds himself forced to reduce his estimates of money and time. In other words, it is the client himself who is too optimistic, and the reason for his optimism lies in the inexactness of the science of engineering.

It follows, therefore, that from such a condition certain difficulties arise. In the first place, the engineer is ignorant of what is below the surface of the earth, and his methods of test do not always give the needed information. Borings give only a meager idea of the rocks and soils, and they tell still less about the pressure which the soil may have on works or what foundation pressures may be regarded as safe. Experiments made with crushed samples are worthless, and even experience often proves an unsafe teacher. Secondly, the engineer must war with the elements. Unforeseen floods may wash away falsework, damage permanent work, or cause expensive delays, while rain, snow, hail and sudden changes of temperature may work havoc with well-conceived plans. His rivers do not behave as he thinks they should. In the third place, the materials with which the engineer must work are not uniform in character, and this lack of uniformity may vitally affect the finished work. He may make computations to his heart's content, but he cannot tell from his results the *actual* stresses in a masonry dam, and must base his designs largely on experience. In the fourth place, the engineer cannot tell with certainty the course of future prices, or how the bidder will estimate them; he cannot tell what factors may influence the bidder, how strong is his desire to get the work, what force of men he must keep employed, what new equipment he must purchase. Yet all these uncertain matters must enter into the engineer's estimate. Obviously they create a considerable margin of uncertainty which the careful engineer fully appreciates, but upon which the client is willing to take a sporting chance.

To overcome the uncertainties due to lack of knowledge Sir Maurice emphasizes the desirability of research and the value of preliminary studies, and praises the spirit which has prompted the governments of Canada and the United States to accumulate facts relating to rainfall, stream flow and other matters. This opinion is of especial interest, as the question is often asked here whether preliminary experimental work has not been carried too far. That it may be carried too far is of course true, but in proportion as our knowledge increases the margin between high and low bids should shrink and benefits result to both client and contractor. Research, rightly conducted, will not only advance the arts of engineering and serve as a protection against gross failures, but it will conduce to better business arrangements between clients and contractors and enhance the professional standing of the engineer himself.

The address closes with an appeal to young engineers to take every opportunity of carrying out experimental work. "Such opportunities occur on nearly every undertaking. It need not be original work, but even the repetition of work previously done gets one interested and accustomed to that class of work and it may be the means of correcting and enlarging the work done by others." These words, coming from so great a master of engineering as Sir Maurice, should be heeded by the young engineers of America.

Armies Out of Work

NOW that all Europe, and indeed America as well, has reached nearly the required maximum of productiveness as far as war supplies are concerned, the industrial problems of the after-war period are coming up for the careful consideration they deserve. While class after class of men have been drafted for strictly military purposes, there has not only been no falling off in the volume of production but an increase of such magnitude that the absolute efficiency of society must have been nearly doubled to account for it. What social effect this will have when the armies are demobilized is giving no little concern to those in authority. Obviously it will not suffice to leave the solution to time and chance, for error here might involve the world to a degree which would endanger civilization itself.

But in the very process of the war will be found a certain measure of relief. The London *Surveyor*, in its annual review number, calls attention to the forced neglect of public works. The cry for economy has led English highway authorities "to reduce their expenditures to such an extent as to jeopardize the very existence of the roads for which they are responsible," in spite of the fact that "war conditions have rendered it more necessary than ever to keep the home roads in a high state of efficiency." As regards bridges, "very few have been built during the year. Indeed, if we allow our survey to extend to the continent of Europe, the record is one of destruction rather than construction."

But here is found only a temporary relief, a definite task set for accomplishment. To repair war's destruction will utilize a certain limited number of men for a limited period, but will afford no new and continuous employment for soldiers whose jobs have been filled by women who will be loath to surrender their new wage independence, since they have fully measured up to the task imposed on them by economic, though patriotic, considerations. It must be realized that feminism will be an even livelier issue in the years of peace to come than ever before.

But, avoiding this last point, there is still the higher unit efficiency of production, and its effect upon available work, to be considered. A unit of value is being produced at half the former time expenditure, and this alone will give a critical tension to after-war conditions unless new fields are opened for development or additional farming lands are made accessible. The possibilities of colonizing the vast and fertile areas of Canada were treated editorially in the Engineering Record on Feb. 3, and no doubt here will be found a permanent and effective method of providing for many thousands of returned soldiers.

Perhaps the most promising of all is the project of greatly extending the network of permanent roads. This will not only stimulate peaceful industry near to the pitch of war-time necessity by making new consumers of cement, steel for bridges and road machines, and motor vehicles, but will make colonization more attractive by bringing it closer to centers of communal life. Every farmer is a consumer of manufactured products, perhaps even to a greater extent, individually, than his city-dwelling brother.

According to J. Duchastel, city engineer of Outremont, a suburb of Montreal, Canada has not only made provisions for new colonization schemes but has now on foot a movement to organize a vast road-building campaign upon which the men returning from European trenches will be used in large numbers. While it is well to appreciate the forethought of our neighbors, we of the United States must not overlook the fact that the new problems will not be confined to Europe and Canada. War's cessation will affect our industrial fabric as well, and unless we are prepared to meet the new conditions in as an efficient manner, trouble will be ours, and in large measures. We also will have a surplus of labor when the demand for war supplies ceases.

Would Redesign Times Square Station for New York's Enlarged Transit System

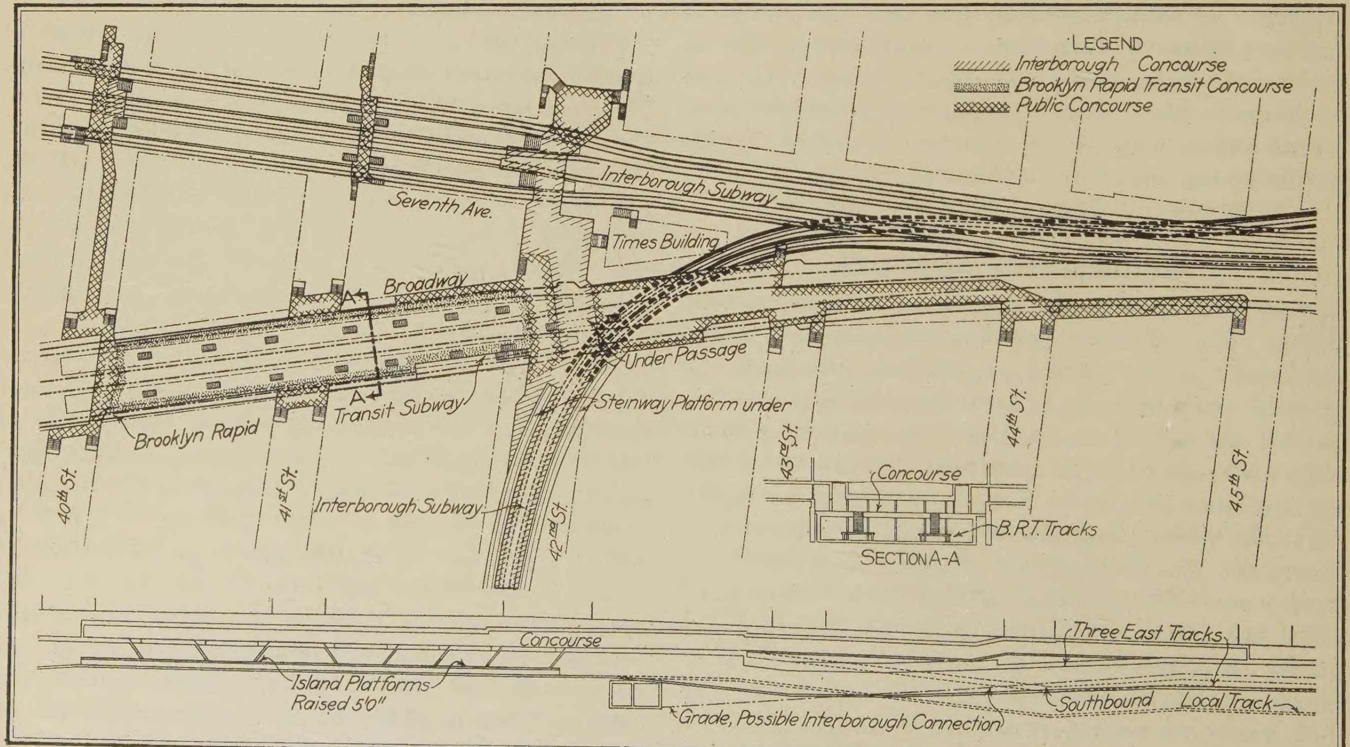
Proposed Plan, Recognizing Changed Conditions, Would Reverse Subway Levels at Intersection and Relieve Expected Congestion by Extensive Concourse

A RADICAL CHANGE in the Times Square station of New York's new dual transit system has been proposed by an association of interested business men. It involves a reversal of levels, at their intersection, of the Brooklyn Rapid Transit subway and the Interborough connection, if made, into Forty-second Street, and an extensive concourse under the streets to keep the patrons of the subways clear of the surface congestion. The project would not have been feasible under the conditions on which the adopted plan was predicated, one of which was the continued operation of the present subway until the opening of the Brooklyn Rapid Transit subway. Changes in other plans, however, make this impossible. Numerous advantages are claimed for the new plan, which is now before the Public Service Commission, and an important point is that in spite of the large amount of work already done at Times Square and the fact that much steel not yet in place has been ordered, the change can be effected with little waste of effort or material.

HEAVY TRAFFIC CONCENTRATED AT ONE SPOT

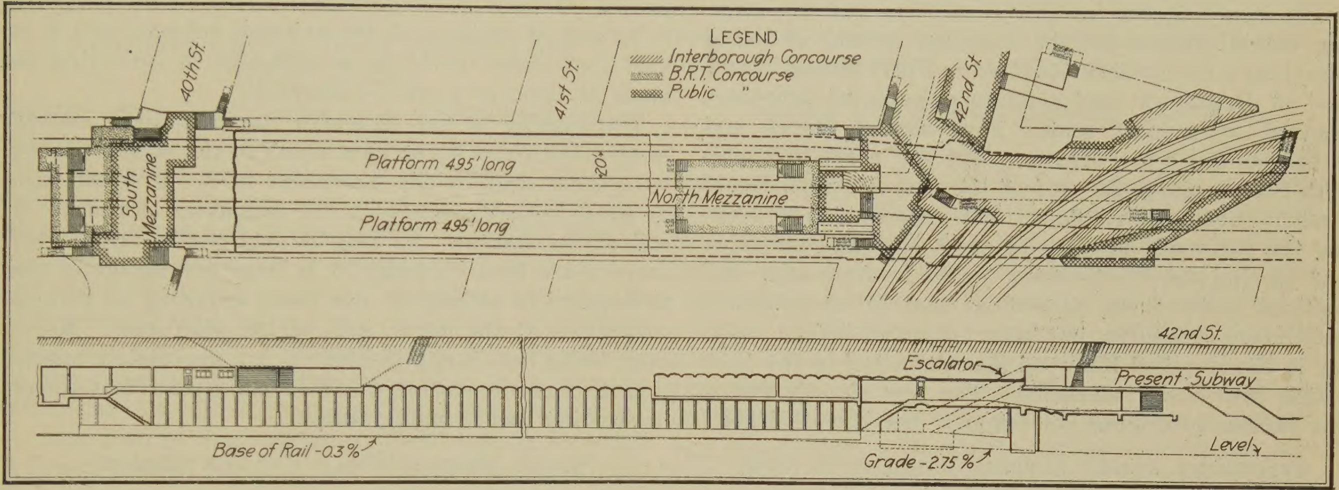
Times Square, New York City, midway between the two railway terminals of Manhattan and in the heart of the retail and theater district, is likely to become the most important focus of rapid transit in that city when the new dual system is put in operation. Here converge, in three connecting terminal or express stations, the Broadway subway of the Brooklyn Rapid Transit lines and the Broadway-Seventh Avenue and Steinway subways of the Interborough lines. A description of the original design for these stations, though not wholly up to date because of subsequent revisions, appeared in the Engineering Record of Feb. 21, 1914, page 230. As now planned, the express station of the Brooklyn Rapid Transit line, located deep beneath Broadway in order to pass under the tracks of the present Interborough subway, is provided with exits only at the ends of its platforms. These exits are separated by 300 ft. Present experience indicates that the 22-ft. platforms will be gravely overcrowded from the start, and passengers to and from the district north of Forty-second Street will be obliged to cross at the surface the already congested intersection of Broadway and Forty-second Street, or pay an extra fare.

Moreover, the connection between the new east-side and west-side lines of the Interborough as planned is by means of turnouts at grade under Seventh Avenue, and could hardly be used safely for passenger-train operation. The structures involved were planned under the necessity of placing the Interborough and the Brooklyn Rapid Transit lines in operation simultaneously. However, the change, forced at the eleventh hour by the city, from a bridge to a tunnel crossing under the East River at Sixtieth Street will postpone through operation of the Broadway line to its northern termini in



PROPOSED STATION LAYOUT WOULD DISTRIBUTE PASSENGERS UNDERGROUND OVER LARGE DISTRICT AND IMPROVE OPERATING FACILITIES

Queens two years beyond the possible opening of the Interborough lines. This delay gives rise to an opportunity to modify the original design, and such action has been proposed to the Public Service Commission by the Broadway Association. The changes suggested are designed, according to this association, to give the Interborough, if desired, an operating connection between its east and west lines, to relieve the threatened platform congestion in the Broadway station and to provide an underground mezzanine concourse enabling the passengers from any of the intersecting lines to reach their destinations on either side of Broadway or Forty-second Street without crossing at the street surface. If made now, the change can be accomplished without sacrificing any of the material ordered for the construction under way. If built as originally planned, the physical limitations of the site would, it is thought, make the reconstruction of this station in the future impossible except at enormous expense.



STATION AS FIRST DESIGNED UNDER NECESSITY OF OPERATING EXISTING TIMES SQUARE STATION TILL LAST MOMENT PRESENTED MANY TRAFFIC DIFFICULTIES

ORIGINAL CONDITIONS NECESSITATED INADEQUATE DESIGN

With the intention contemplated in the dual system contracts of keeping the existing subway in operation until all the new lines were actually opened, it was found necessary to depress the Broadway tracks of the Brooklyn Rapid Transit Company to pass under the existing Interborough subway at Times Square, where it turns into Forty-second Street. Further headroom was lost in this design by reason of the necessity for a heavy roof on the new structure to carry the train loads from the old. It was further decided to connect the present northbound tracks from Forty-second Street to the new Interborough subway, and stub-end the present southbound tracks for the terminal of the Steinway line under Forty-second Street.

Although operating connections on the east end at Park Avenue to any pair of these Forty-second Street tracks are perfectly feasible, the present layout would make an operating connection at the west end impossible, because southbound trains from the upper Broadway line would have to cross two or more tracks at grade in order to reach Forty-second Street. The plan makes it impossible to convert the existing Times Square station into a large concourse because of the gap cut in it by the two tracks which are to remain. It is planned, however, to leave the existing underpassage at Times Square to connect these two platforms.

BROOKLYN PASSENGERS CANNOT CROSS UNDER FORTY-SECOND STREET

As may be seen from the accompanying plan of the Broadway station as now being constructed, access to the trains is by means of island platforms 22 ft. wide, which connect at the south end by stairs and at the north end by stairs and escalators with small mezzanines. These exits are about 300 ft. apart. It is evident from the location of the controls shown on the plan that Brooklyn Rapid Transit passengers coming from or bound to points north of Forty-second Street would be obliged to cross that street at the surface or to pay the Interborough a fare for the privilege of entering or leaving the concourse under Forty-second Street from the north side.

Once built and backfilled, it would be impossible to provide additional exit facilities from this station either at Forty-first Street or through adjoining buildings without decking Broadway for a second time and removing this backfill. The street intersections at Times Square are already among the most congested and dangerous to pedestrians in the metropolitan district. With vehicular traffic on the increase, and with the great increase in foot travel brought to this point by the converging rapid-transit lines, this district, it is argued, would soon become, under the present plan, the scene of the most serious traffic problem ever presented to New York City.

CHANGES TO IMPROVE CONDITIONS

Now that it is apparent that the Brooklyn Rapid Transit Company cannot operate the Broadway line until after the Interborough is operating its new east and west subways, and there is an opportunity to remove the threatened congestion at Times Square, the Broadway Association has urged the Public Service Commission to take advantage of this fact and modify the present design so that no passengers from either of the three converging lines will be obliged to cross Forty-second Street or Broadway on the surface, so that the Brooklyn Rapid Transit station will be brought nearer the street surface and the threatened platform congestion entirely relieved, and so that an operating connection, if found advisable, may be established from the Grand Central Terminal to the upper West Side.

This will be accomplished by raising the new Brooklyn Rapid Transit line till its roof forms the floor of the concourse under Forty-second Street; depressing the connection between Forty-second Street and the upper Broadway line, if this connection is insisted on, beneath this structure; using the existing center tracks under Forty-second Street for this connection and the existing outside tracks for the Steinway tunnel, and constructing a double-deck terminal in Forty-second Street east of Broadway; and extending the small concourse planned at present under Forty-second Street and Broadway south to Fortieth Street and north to Forty-fifth Street, using the roof of the new Brooklyn Rapid Transit subway as its floor. The general idea of keeping the two main subways at about the same elevation and passing the Forty-second Street Interborough connections under them, as well as that of an extensive subsurface concourse, has been presented before, notably in the so-called Harwood plan described in the 1914 article previously mentioned. The new plan, however, has various provisions not found in the Harwood plan.

TEMPORARY STREET SUPPORT UTILIZED TO ROOF CONCOURSE

The contractor for this section of the Brooklyn Rapid Transit line has employed a steel framework to support the street decking. This framework is at the approximate level proposed for the roof of the mezzanine concourse. As described in the Engineering Record of Dec. 23, 1916, page 760, it consists of a central longitudinal line of heavy girder beams into each side of which are framed I-beams at 10-ft. intervals. Supported by cast-iron columns and concrete sidewalks, this framework could be incorporated into a concrete roof which would support the far lighter backfill and the street loads, and which would conform to the specifications governing the design of the new subways. The ends of the transverse I-beams extend far enough to rest at the sides on the concrete walls of the concourse. In view of the present difficulty of obtaining deliveries on structural steelwork, the possibility of utilizing this steel already in place, and of avoiding the purchase of any considerable tonnage of new steel, is considered one of the strongest arguments in favor of the practicability of the proposed plan.

PROPOSED CONCOURSE AMPLE IN SIZE

The proposed concourse between the Interborough controls at the east side of Seventh Avenue and the east side of Broadway, and north of the Brooklyn Rapid Transit control at the south side of Forty-second Street would be open to the public. The existence of such a concourse, it is held, would solve the traffic difficulty at Broadway and Forty-second Street by providing an undercrossing for pedestrians in any direction.

Because it would be possible to provide a wide center platform between the stub tracks of the Steinway line over the depressed center tracks forming the connection between the Interborough lines, adequate platform facilities for this terminal would be provided without the necessity for widening the present structure.

The platform congestion threatened under the present plan in the Brooklyn Rapid Transit express station would be relieved by placing narrow stairs from these platforms to the mezzanine floor at frequent intervals, so that no passenger would be obliged to walk more than a few feet after leaving a train before reaching a stair leading to a concourse so large as to obviate congestion.

From this concourse exits could be provided as traffic increased at every street corner and into any building along Broadway. Such connections have already proved valuable to real-estate owners whose property is located at stations of the existing subway, and it is held that there would be no difficulty in providing as many of them as would be desirable.

The raising of the Brooklyn Rapid Transit station level would result in an easy climb to the street, broken by a short walk at the mezzanine level. It would also do away with the necessity for escalators at the north end of the station. As long as such escalators existed there would be a tendency for a large percentage of the passengers to attempt to use them, resulting in serious congestion at the upper ends of the platforms. Moreover, being on a hump instead of in a depression, operation through the station would consume much less power in starting and stopping trains.

BOOTH RENTAL WOULD PAY FOR CHANGE

The total area of the concourse provided by this change would be approximately 35,000 sq. ft. Prevailing rents for basement space along this section of Broadway are already $2 annually per square foot. Such property is far less valuable than booth space in a concourse of this character would be. The Broadway Association considers that $4 to $5 per square foot would not be too high an estimate for the revenue to be obtained from such a source. If 10,000 or 12,000 sq. ft. of the space so provided were thus utilized, the rental return capitalized would, it is estimated, cover the cost of making the changes proposed.

POSSIBLE EXTENSION TO WEST FORTY-SECOND STREET FERRIES

The headroom saved by raising the Brooklyn Rapid Transit tracks to a bare clearance under the floor of the concourse, in addition to that gained by the elimination of heavy girders to carry existing tracks in the Times Square station, would make the deepest point of the excavation for the connection between the existing Forty-second Street and upper Broadway lines, if built, only 8 ft. below the excavation required by the present plans for the Brooklyn Rapid Transit subway at this point. The north center track, which is the northbound express track of the existing subway, would pass beneath the Brooklyn Rapid Transit structure, come up between it and the existing subway and break to the left into the northbound local of that structure. The south center track, the southbound express track of the present subway, would pass beneath the Brooklyn Rapid Transit structure and beneath the Interborough structure, come up on the west side of that structure and break into its southbound local track in the neighborhood of Forty-fifth Street.

Under this plan the Steinway tracks, which have already been extended a considerable distance beyond Park Avenue under Forty-second Street, would be connected with the present pair of express tracks instead of with the present pair of southbound tracks. If it becomes desirable in the future to extend the Steinway tracks west to the Forty-second Street Hudson River ferries, a tunnel can be driven beneath the new Interborough subway on Seventh Avenue tangent to the center tracks forming the connection with the Interborough. Crossovers could be constructed in the Forty-second Street subway so that, if the physical connection were made, Interborough trains could take the center tracks.

COULD GIVE PARTIAL TRAIN SERVICE OVER PRESENT ROUTE

On the other hand, under this arrangement trains from the downtown East Side could be operated through to Times Square, thus making it unnecessary for the East Side line to operate half-empty trains during the rush hours above the Grand Central into The Bronx. This operating condition is considered likely to arise under the present plan because of the heavy commuting traffic entering and leaving the subway at the Grand Central Terminal. It is pointed out in this connection that the present subway has resulted in a residential distribution placing on the upper West Side many persons who wish to reach points on Park Avenue between the Grand Central Terminal and Fourteenth Street, and that under the present plans, until a considerable redistribution takes place, these passengers would be at a great disadvantage. Under this plan these passengers would transfer direct from expresses at Times Square to the locals bound for their destination.

CONSTRUCTION DIFFICULTIES NOT GREAT

The investigations of the Broadway Association show, it is stated, that the only important contract to be modified in carrying out the proposed change is that with the Holbrook, Cabot & Rollins Corporation for the construction of the section of the Brooklyn Rapid Transit subway extending from Thirty-eighth Street to Fifty-first Street, as no extensive modifications of the Interborough West Side subway are involved, and as contracts have not yet been awarded covering the Steinway terminal.

As regards changing the construction work on this contract, it is stated that all the steelwork for this section has been ordered except that for a short distance beneath the present Times Square station, the designs for which have not yet been approved by the engineers of the Public Service Commission. This one section, however, includes practically all the steelwork, the design of which would be greatly modified by the carrying out of the proposed change. The remaining steel in sections affected by the proposed change would be used as ordered, except that it would be set to the new grade line. Only a few bents of this steel have as yet been erected, and raising these to the new level would, it is said, involve little expense. It is stated that while the southbound track connecting with the Interborough, if this connection is decided on, would involve tunnel construction, the northbound track and all of the extra construction east of the Interborough structure could be carried on with ease and economy from the excavation already made for the Brooklyn Rapid Transit subway. Very little of this latter cut is at present excavated below grade, as it was considered inadvisable to start excavation in the deep section beneath the present Times Square station in advance of the approval of the steel design.

The apparent difficulty of constructing exits into the buildings along Broadway below Forty-second Street on account of the ventilator wells at the sides of this station no longer exists. The scheme for ventilating this section of the subway has been modified, so that these wells are to be covered with vault lights, and employed to admit daylight to the station. They could be cut through at as many points as necessary without detriment to the ventilation of the station.

ACTION ON PROPOSAL EXPECTED SHORTLY

The progress of construction work on this section will soon have reached a point, it is stated, where considerable expense would be involved in making the change. Also, it is considered desirable to complete the station below Forty-second Street at an early date as a terminal for partial operation of the Brooklyn Rapid Transit subway. On account of these considerations, it is expected that the Public Service Commission will act on the proposal without delay. The committee of the Broadway Association which has had charge of presenting this change to the Public Service Commission consists of J. E. Harrington, chairman; Howard Brokaw, John G. Boggs, J. de M. Thompson and E. W. Estes.

Engineering Co-operative Methods Outlined

Scheme to Be Presented by Subcommittee at Third Annual Conference to Be Held in Chicago, March 29 and 30

IN ACCORDANCE with the resolutions adopted at the second Conference on Engineering Co-operation, a subcommittee, consisting of F. H. Newell, chairman, Hunter McDonald, Morris L. Cooke, C. E. Drayer and Isham Randolph, was empowered to prepare a plan for forwarding co-operation among engineering societies upon matters of general interest to the engineering profession, such plans to be presented for formal consideration at a third conference on engineering co-operation to be called by the subcommittee at such time and place as seemed to it desirable. The several organizations represented at this conference were to be presented with an estimate of probable expenditure which might be incurred by the subcommittee, and they were to be permitted to assist in defraying the expenses.

The following fundamentals were discussed and adopted for presentation at the third conference:

1. *National Societies*—As a preliminary to all efforts toward co-operation among existing engineering organizations there should be the expressed intent to assist in strengthening and unifying the work of the national engineering societies in the advancement of engineering knowledge and practice, and the maintenance of high professional standards.

2. *Local Organizations*—The invigorating of local societies is fundamental because of the fact that while

the great national societies are important in setting standards and in considering broad problems, yet local affairs make up at least nine-tenths of the vital problems of the engineer's life. In each locality where there may be a dozen or more engineers so situated as to be able to meet occasionally, there should be formed, if not already existing, an engineering association embracing all professional engineers, and others interested in engineering, to discuss and act upon these vital problems.

3. *Home Rule*—Each local engineering society should be autonomous or self-governed, wholly free in its activities from any dictation or control by other association or connections, fully adapted to local needs and conditions, and exemplifying in its activities the principle of complete home rule.

4. *Welfare of Members*—Each such local or self-governing unit in its organizations and activities should give full recognition to the fact that the majority of the membership necessarily consists of men not yet enjoying complete or independent professional status, but who in large part have had a college or technical training and who in time may become professional engineers in the full sense of the word. Because of this diverse character of members, the activities of the local society, while maintaining high professional standards, should be so planned as to meet the needs of the young men as well as the older and be directed toward the welfare of all classes of its members and, through them, of the public.

5. *Ethics*—Each local engineering society should adopt and frequently make application of a code of ethics prepared in accord with the standards established by the national organizations or approved by other professional bodies. It is recognized that while it is impossible to prevent all violation of such a code, yet eternal vigilance is the price of maintenance of high standards. The enforcement of such a code is essential to the well being of the community at large, as well as for the protection of professional men from the improper competition of unskilled or unscrupulous men tending to reduce the opportunity for effective service to individuals and to the public.

6. *Employment*—For the benefit of the great body of members, those who have not yet attained a standing which enables them to enjoy full professional status, there is needed the development of a scientifically planned and well conducted system of employment to be operated in co-operation by all engineering associations.

7. *Publicity*—Each independent association should maintain a local system of diffusing information on engineering subjects such as may be embraced in the term publicity, or of properly advertising the profession as a whole.

8. *Civic Affairs*—Each local society should devote time and thought to local civic, state and national affairs which influence engineering progress, and should take an active part in considering proposed new laws.

9. *Intermediate Societies*—With complete covering of the ground by vigorous local city and state associations, it is evident that there is no room for an intermediate engineering society such as the Engineering Association of the South, which has recently disbanded with the expectation that strong organizations will succeed it in each of the cities where it has been represented by local sections. Such autonomous societies better fill the need of bringing engineers together in personal contact, arousing the spirit of fellowship and facilitating prompt action.

10. *The Public Engineer*—Each local society should give especial attention to the needs of those members who are in public employment, and should recognize the high ideals and performance of the public engineer, seeing to it that he is furnished sympathetic support in his efforts in the public service.

11. *Conferences*—An occasional conference of representatives from each engineering organization should be held at least annually, at which all matters such as those noted and others of general interest should be discussed. The expense of one delegate to such conference should be provided by each society.

12. *Field Secretary*—Provision should be made for maintaining a traveling secretary of the committee on co-operation who can visit each local body, give personal advice and assistance in ways which may aid in securing the highest efficiency and economy in administration, and who can address the membership on larger matters of concern to all engineers.

13. *Local Representative*—In each society efforts should be made to develop one or more of the younger members with especial reference to active participation in the co-operative movement, particularly to the diffusion of information on engineering in ways such as will catch and hold the public attention.

14. *Printed Matter*—An ample supply of printed matter should be provided for distribution, covering in particular the methods of organization of engineering societies, the maintenance of ethical standards, the ways of securing employment, and of diffusing information; also on other details which are of importance to officers and members of local societies and which will tend to stimulate interest and secure results in the business operations of the society.

Suitable standard blanks and letter forms should be made available for general use in obtaining information concerning employment and for correspondence with persons seeking work so that the necessary facts may be fully and quickly obtained.

15. *Finances*—In order to pay for typewriting, printing, postage and similar expenses, it is necessary to have a small fund at the disposal of the committee on engineering co-operation. At present it is not advisable to ask each of the various engineering organizations to contribute beyond the expense of sending delegates to the conference. In some localities, however, it appears that money may be raised by personal appeal instead of direct assessment, although it is hoped that each organization in time will contribute.

Good Roads Are Better Than Concrete Forts

Though modern artillery ranges are great, the precision of fire-control has been so developed that the heavy mobile howitzers make short work of permanent fortifications. Any system of defensive strategy, based on heavy guns permanently mounted, has been proved inadequate. With good roads the defensive army can adapt itself to the fluid conditions of modern war and, by rapid shifting of artillery, avoid the mistakes of the defenders of Liége.

Transformed-Section Analysis of Reinforced-Concrete Beams

Investigation of Given Sections by Direct Computation for Position of Neutral Axis, Moment of Inertia and Fiber Stresses

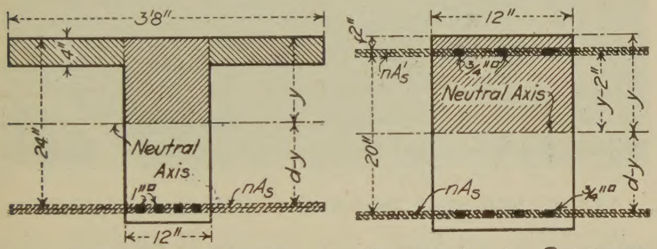
By J. H. CISSEL
Instructor in Civil Engineering, University of Michigan, Ann Arbor, Mich.

LONG and cumbersome formulas for the analysis of T-beams, beams reinforced for compression and other more complex sections can be avoided by a simple application of general methods of solution to the homogeneous transformed section. Such a general solution is here presented, based upon the standard notation, and using the homogeneous section easily obtained by multiplying the steel areas by n, the ratio of the moduli of elasticity of steel and concrete. Thus an equivalent concrete section is obtained, to which the ordinary principles of analysis for homogeneous beams are applied. An equivalent steel section could as well be used if desired.

[The article by W. S. Wolfe, on page 473 of this issue, gives the graphical solution of similar problems. It may be found that a combination of the two methods, in some cases, will be most effective.—EDITOR.]

GENERAL CASE OF TRANSFORMED SECTION

Adopting the usual fundamental assumptions for the analysis of reinforced-concrete beams, based upon the straight-line theory, it can easily be shown that an equivalent homogeneous concrete section will be obtained by multiplying the steel area by n. The neutral axis can then be located at the centroid, or center of gravity, of the transformed section. This is done most conveniently by equating the statical moment of the equivalent area on one side to the statical moment of that on the other side.



T-BEAM SECTION RECTANGULAR SECTION

NOTATION AND DIMENSIONS FOR ANALYSIS OF CONCRETE BEAMS

Knowing the position of the neutral axis, the moment of inertia of the transformed section with respect to this axis may be calculated, and the well-known fundamental formula $M = f\,I/y$ used to find the resisting moments for a given section, or the fiber stresses produced by a given bending moment.

The accompanying diagram gives the dimensions and notation used for the exact analysis of a reinforced-concrete T-beam, including the effect of the compression in the concrete of the stem above the neutral axis. To compute the safe resisting moment for this beam when $A_s = 4$ sq. in., $n = 15$, $f_s = 16{,}000$ and $f_c = 650$, the compressive area is divided, for convenience, into the parts shown in the figure. Equating the statical moments with respect to the neutral axis of the transformed steel and the concrete,

$$(32 \times 4)\ (y - 2) + \frac{12y^2}{2} = 60(24 - y)$$

Solving,

$$y = 7.31 \text{ and } d - y = 16.69$$

The moment of inertia about this axis can then be computed as follows:

$$nI_s = 15 \times 4 \times (16.69)^2 = \qquad 16{,}713$$

$$I_c = \left(44 \times 7.31^3 \times \frac{1}{3}\right) - \left(32 \times 3.31^3 \times \frac{1}{3}\right) = 5{,}342$$

$$I = I_c + nI_s = \qquad 22{,}055$$

The resisting moments are therefore:

$$\frac{f_c I}{y} = M_c = \frac{650 \times 22{,}055}{7.31} = 1{,}960{,}000 \text{ lb.-in.}$$

$$\frac{f_s I}{n(d - y)} = M_s = \frac{16{,}000 \times 22{,}055}{15 \times 16.69} = 1{,}410{,}000 \text{ lb.-in.}$$

The safe resisting moment is thus 1,410,000—given by the steel.

Given the rectangular beam shown in the diagram subjected to a positive bending moment of 760,000 in.-lb. with $n = 15$, $A_s = 2.25$ sq. in., and $A'_s = 1.69$ sq. in., to compute the fiber stresses in the steel and concrete, proceed as follows:

The transformed area of compressive steel $= 15 \times 1.69 = 25.4$
The transformed area of tensile steel $= 15 \times 2.25 = 33.8$

Equating statical moments of tensile and compressive areas about the neutral axis (using transformed section):

$$\frac{12y^2}{2} + 25.4(y - 2) = 33.8(22 - y)$$

Solving, $y = 7.58''$ and $d - y = 14.42''$

Then the moment of inertia will be:

$$nI_s' = 15 \times 1.69 \times (5.58)^2 = 789$$

$$nI_s = 15 \times 2.25 \times (14.42)^2 = 7018$$

$$I_c = 12 \times (7.58)^3 \times \frac{1}{3} = 1742$$

$$I = I_c + nI_s + nI_s' = 9549$$

Therefore the fiber stresses are:

$$f_c = \frac{My}{I} = \frac{760{,}000 \times 7.58}{9549} = 605$$

$$f_s' = \frac{nM(y - 2)}{I} = \frac{760{,}000 \times 5.58 \times 15}{9549} = 6680$$

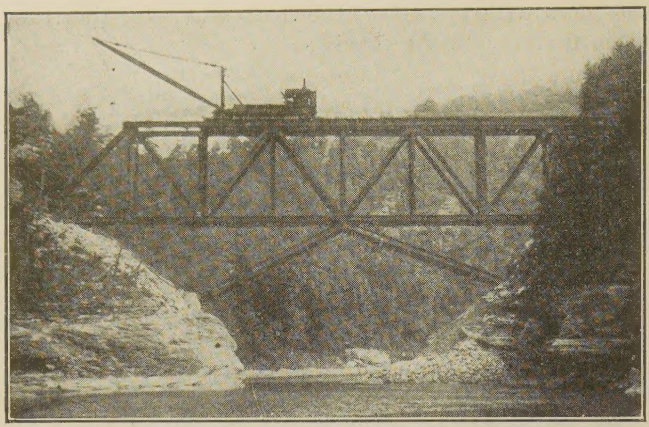
$$f_s = \frac{nM(22 - y)}{I} = \frac{760{,}000 \times 14.42 \times 15}{9549} = 17{,}300$$

Correction of Formula for Locating Neutral Axis of Inclined Purlins

William Vetter, of Springfield, Ill., points out that the formula for tan θ given in the second column of Mr. Fleming's article on page 347 of the issue of March 3 should read

$$\tan \theta = -\tan \alpha\, \frac{I_u}{I_v}$$

In other words, the ratio of the moments of inertia was inverted in the original article.

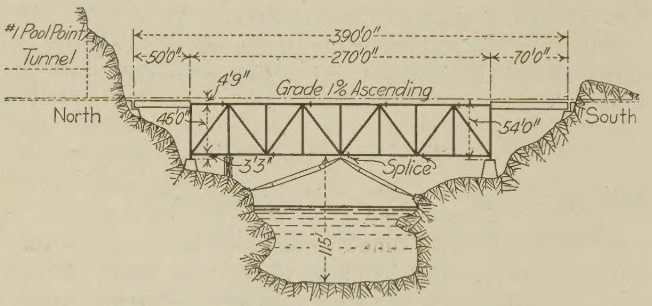


ERECTION OF 270-FOOT SPAN APPROACHING COMPLETION

Pool Point Bridge Erected by Using A-Frame Over Deep Water

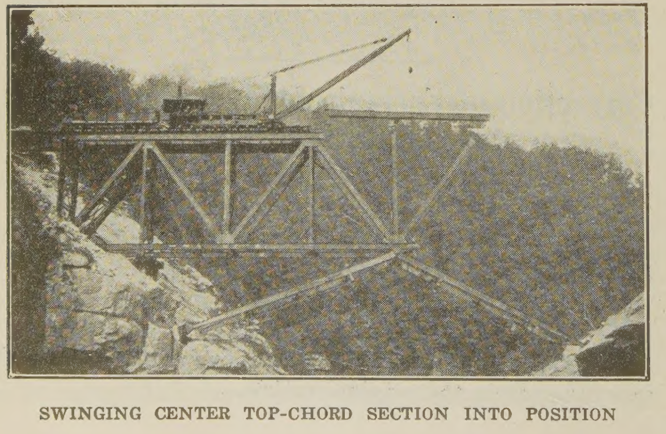
Derrick Booms for Legs Fleeted Out Over Ravine and Brought to Bearing on Concrete Pedestals Placed on Rocky Side Walls

AN EXAMPLE of the solution of a difficult erection problem through taking advantage of the exceptional natural conditions is seen in the methods adopted in the case of the Pool Point Bridge on the Elkhorn extension of the Carolina, Clinchfield & Ohio Railway. This bridge crosses Russell Fork, a branch of the Big Sandy River, about 2 miles south of Elkhorn City., Ky., a short distance from the Virginia state line. At this point a deep basin, in which there is always from 50 to 90 ft. of water, has been formed in the rocky bed of the stream. This stream is of torrential character, and above the site of the bridge is a splash dam which at times discharges large numbers of logs which would carry out any ordinary falsework.



CENTER SUPPORT WAS PROVIDED FOR CANTILEVER ERECTION

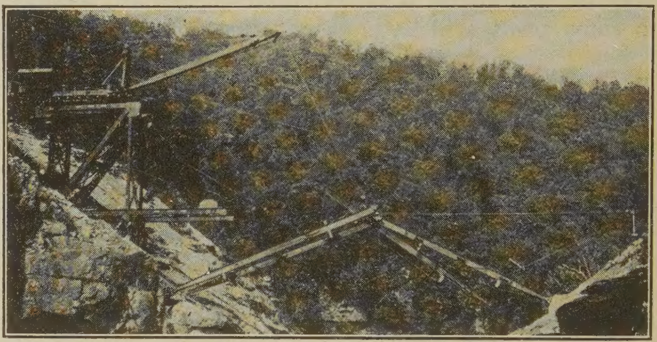
These special conditions made it impracticable to use falsework of the usual type. The character of the rocky side walls suggested the use of an A-frame or arch type of center support and cantilever erection from the north shore for the 270-ft. main truss span. This design was therefore made of the riveted type, with provision for compression in the lower chords and proper sections throughout for cantilever erection beyond the center-panel point. The A-frame legs, made of derrick booms, were fleeted out by derrick cars from the north end, where material was delivered through the tunnel, which is 634 ft. long and by which the railroad reaches the bridge.



SWINGING CENTER TOP-CHORD SECTION INTO POSITION

The main truss span of nine 30-ft. panels, 270 ft. long, flanked on the north by a 50-ft. girder span and on the south by a 70-ft. girder span, as shown in the diagram, is composed of two trusses spaced 19 ft. apart on centers. The bridge is designed for Cooper's E-60 live loading, and the main span weighs 613 tons. The order of procedure in the erection of these main spans was as follows:

The end post and 50-ft. plate girder span having been erected by the derrick car at the mouth of the tunnel, the car could be advanced and the first panel placed with a temporary wooden bent at panel point L_1, as shown. The car was then advanced and the A-frame legs, consisting of derrick booms with temporary trussing, were placed on the north side and held in position by guys. Following this, lines having been passed to the other bank, the south legs of the A-frame were swung or fleeted over.



A-FRAME LEGS OF 16 TONS EACH PLACED BY OUTHAULING

The shore ends of the A-frame had cast-steel bolsters supported on concrete skewbacks and the tops were provided with cast-steel shoes for supporting the truss. The A-frame being in place, the remaining panels up to the center were erected, the splices being located as shown on the diagram, and the center panel point blocked up on top of the A-frame. From this point cantilever erection proceeded regularly panel by panel until the shoe at the south end had been placed.

The deflection of the cantilever end was about 8 in., and care had been taken to block the center high enough to bring the south end about a foot high, allowing for this deflection. Jacks were then applied and this south end lifted until the span was free at the center. The A-frame was removed and the span lowered to the masonry.

The steel work was designed, fabricated and erected late in 1913 by the American Bridge Company. Richard Khuen, Jr., was then division engineer; H. A. Greene, erecting manager, and L. H. Shoemaker, designing engineer.

Tests Indicate Drain-Tile Beddings Increase Strength

Careful Earth Bedding Raises Cracking Strength 25 Per Cent and Some Forms of Concrete Bedding 90 Per Cent

EXPERIMENTS on bedding drain tile in different ways, made at the Iowa Engineering Experiment Station, indicate that an increase in strength of 25 per cent may be obtained by careful earth bedding and as much as 90 per cent by certain forms of concrete bedding. W. J. Schick, drainage engineer for the station, gives the results, abstracted below, in a paper prepared for the recent convention of the American Concrete Pipe Association.

In general the tests consisted of bedding pipe in shallow trenches and then loading them through a standard upper sand bedding. The first series of tests were made with five 24-in. sewer pipe purchased at a reduced price from the Iowa Pipe & Tile Company of Des Moines. The second series of tests was made with five 24-in. drain tile donated by the Mason City Brick & Tile Company.

PIPE LAID IN SHALLOW TRENCHES

In each series of tests the pipe were laid in shallow trenches 6 in. wider than the outside diameter of the pipe, in soils essentially similar to some of those which may be encountered in construction work. The top soil in each case was a black loam and the subsoil a yellow clay. It so happened that the weather conditions at the time each series of pipe was laid were such that the ground was very dry and hard. For this reason, and more particularly to insure uniformity, the specified dimensions and shapes of trenches were adhered to more closely than would be the case in actual construction work. The work in other respects was no better than might be required of a careful contractor.

For beddings of Class 1, or "ordinary" earth bedding, the trench bottom was shaped accurately to fit the lower 90 deg. of the outside circumference of the pipe. The filling material, loose loam, was shoveled in without placing or tamping.

The results of tests of pipe in this type of bedding are only corroboration of the results of investigations of a large number of constructed drains and sewers. In no case were cracked pipe found in any drain or sewer, where the pipe were bedded in this way, when the strength of the pipe was one and one-half times the calculated load of the filling material.

TRENCH BOTTOM SHAPED

The second type of bedding investigated, termed Class 2, or "first class" earth bedding, was representative of the best practice in earth beddings in drain and sewer construction. The trench bottom was shaped to fit, approximately, the lower 90 deg. of the circumference of the pipe and then covered with about 1 in. of loose earth. The pipe was firmly bedded upon this layer of earth and loose loam tightly tamped in at the sides of the pipe, the filling in these tests being carried up above the midheight of the pipe. In this case, as in the beddings of Class 1, the work was more carefully and uniformly done than is common in construction work.

The tests of these pipe showed that this bedding increased the cracking strength of the pipe. From these results and those of examinations of constructed drains and sewers, it seems that pipe bedded in "first-class" earth beddings, such as are prescribed in the standard specifications of the American Society for Testing Materials, will have 25 per cent more supporting strength than similar pipe in the standard-strength test.

The third type of earth bedding tested was constructed by laying the pipe in a flat-bottomed trench and shoveling in the filling material without either placing or tamping. In reality such construction represents a lack of bedding rather than a type of bedding, but at that it is representative of some drainage construction. The tests of pipe so laid showed them to have less supporting strength than in the standard sand bedding strength tests or in Class 1 earth beddings. The tests so far made indicate that pipe so laid cannot safely be counted upon to support more than 85 to 90 per cent as much load as that in the standard-strength test.

SAND BEDDING OF DOUBTFUL VALUE

The first type of sand bedding tested was constructed by placing a 4-in. layer of fairly clean pit-run gravel or sand screened through a No. 4 screen in a flat-bottomed trench, wetting the sand and then placing the pipe upon it. Sand was then filled in at the sides up to a point above the midheight of the pipe. Just before the tests were made the sand was wet down so as to have all the sand in the bedding damp but not saturated. The sand was held even with the ends of the tile with boards held in place by stakes. It is possible that these boards allowed of some movement before the tile cracked, and observation during the tests showed that there was a very noticeable movement, at both top and ends, when the loading was continued after the tile had cracked.

During the past summer some tests of 18-in. sewer pipe in a special sand bedding were made in the laboratory. The work was done in connection with investigations of some sewer trouble, so that the bedding of the pipe reproduced, as nearly as possible, the conditions in this sewer. The pipe were bedded on about 5 in. of sand and then sand filled in around them up to one-fourth the diameter of the pipe above its midheight. The sand at the midheight of the pipe was about 13 in. thick. The pipe were bedded in a very rigid wooden box of the required dimensions and a plank bolted onto the top of the box at each side of the tile, parallel to it but not touching it. These planks prevented any upward movement of the dry sand when the pipe was loaded. The pipe were loaded through a standard upper sand box covering the whole length of the pipe.

PIPE BEDDED IN SAND HAVE GREATER SUPPORTING STRENGTH

Both of these tests indicated that pipe bedded in sand will have a supporting strength 25 to 30 per cent in excess of their average ordinary supporting strength, as given by standard-strength tests. The cost of securing sand in many places and its undesirability around drain tile, together with the fact that pipe in sand beddings have but very little more strength than pipe in "first-class" earth beddings, make this type of bedding of doubtful value in all drainage work and in most sewer work.

Mr. Schlick was careful to state that the investigations of the supporting strength of pipe in concrete beddings have not been carried far enough to warrant any definite conclusions as to the value of the different types of bedding, but some brief descriptions of the beddings tested and general statements of the results so far obtained may be of value.

SOME QUESTIONS RAISED BY CONCRETE BEDDING

In making all types of concrete bedding described below, the trench was dug about 6 in. wider than the outside diameter of the body of the pipe. The pipe were bedded so that a space of about 6 in. was left between the ends of adjacent pipe, the concrete being held even with the ends of the tile by boards held in place by stakes.

These tests indicate clearly that there are some additional questions which must be considered in calculating the strength of a pipe bedded in concrete. It seems that the percentage of increase in supporting strength which any given type of bedding will cause for different types may vary inversely, though not necessarily proportionately, with the strength of the pipe. This is more noticeable in the case of beddings which have in themselves some resistance to side pressure, and is thought to be due to the fact that the actual strength of the bedding is the same for all kinds of pipe. The strength which the concrete in the bedding will develop by the time the pipe are loaded depends on the degree to which the concrete has been cured, and so depends upon the same conditions which control this factor for all other concrete structures. Because of these uncertainties and because the investigations have not been carried far enough to warrant definite conclusions regarding the value of the different types of concrete bedding, the percentages given here are only indicative.

CONCRETE BEDDINGS IN SOLID SOILS GIVE HIGH VALUES

A bedding constructed by placing the pipe on earth for 90 deg., as in Class 1, and filling the spaces at the sides with 1 to 8 concrete up to a height of one-fourth the nominal diameter of the pipe above its midheight, increased the supporting strength of the pipe 50 to 60 per cent.

A concrete bedding in which the trench bottom is shaped to fit, approximately, the lower 90 deg. of the pipe and 2 in. of concrete placed under the pipe, with concrete at the sides, as previously described, increased the strength of the pipe 60 to 70 per cent.

A bedding constructed by laying the pipe in a flat-bottomed trench and filling in at the sides of the pipe, up to the height of one-fourth the nominal diameter above the midheight with 1 to 8 concrete, increased the strength of the pipe 80 to 90 per cent.

YIELDING SOIL GIVES NO LATERAL SUPPORT

As it was impossible to reproduce the conditions in a trench dug in what is termed yielding soil, and to be sure that the conditions were the same for different pipe, a method more severe was used. When the concrete in beddings of this general type had taken its initial set, the earth was dug away at the sides. This procedure is justified by the fact that it is very improbable that any soil termed yielding would give the bedded pipe any side support until after it had cracked and deformed.

The first type of concrete bedding for yielding soils was constructed by digging a flat-bottomed trench, placing 5 in. of 1 to 5 concrete in it, placing the pipe upon this layer of concrete and filling in with concrete at the sides up to the height mentioned for other types of bedding. After the concrete had set, the earth was dug away at the sides so that the concrete bedding received no side support. The few tests made indicated that such a bedding in a yielding soil will increase the strength of the pipe 40 to 50 per cent. The second type of concrete bedding for yielding soils was constructed by bedding the lower 90 deg. of the pipe upon earth, as in Class 1, and filling in at the sides with 1 to 8 concrete up to a height of one-fourth the diameter of the pipe above the midheight. When tested with the earth dug away outside, the concrete pipe in this bedding had less strength than pipe in the earth beddings of Class 2, "first class."

CONCRETE BEDDING GOOD IN ANY SOIL

The one bedding of this general type was patterned after a concrete bedding used by the Philadelphia Board of Public Works and will be of equal value in all soils firm enough to prevent vertical settlement. This bedding was constructed by placing a layer of concrete in a flat-bottomed trench, placing the pipe thereon and then filling in at the sides with 1 to 8 concrete up to a height of one-fourth the diameter of the pipe above the outside of the pipe at the bottom. In the tests with 24-in. sewer pipe the minimum depth of concrete under the pipe was made 5 in. When these pipe were tested none of the beddings were cracked, indicating that the beddings were stronger than the pipe required. When the 24-in. drain tile were bedded in this type of bedding the thickness of the layer of concrete in the bottom was reduced to 3 in. After these pipe were tested, very fine cracks were found in the bottom of three of the five beddings. None of these cracks were visible until after the tile had collapsed, so that it is possible that they may have been caused by the fall of the upper segments of the tile and the upper sand box and blocking. Such a bedding increased the strength of the pipe 60 to 70 per cent.

Considerable caution should be used in applying the results of tests of pipe in concrete beddings, Mr. Slick stated, because these values depend only on tests of ten pipe of two kinds and all of one size.

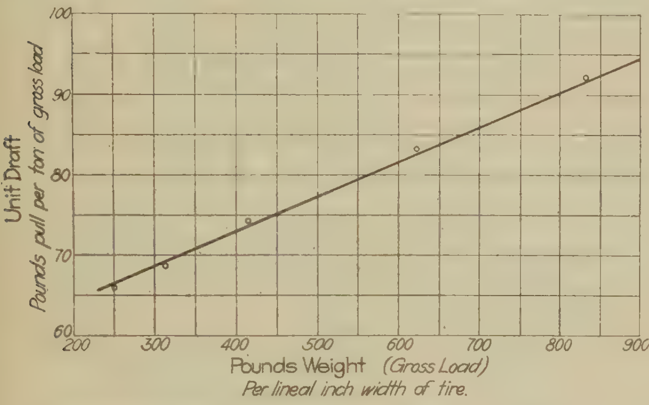
Cheap Power Attracts Nitrogen Plant to Washington

A nitrogen plant is being erected at La Grande, Wash., near the Tacoma municipal power plant, from which source power was contracted for at a rate of 1.15 mills per kilowatt-hour. The power sold is surplus which the plant does not require at present and the municipality retains the privilege of discontinuing service at any time. The American Nitrogen Products Company is erecting the plant, which is reported to involve a $500,000 investment.

Traction Is a Straight-Line Function of Tire Width

Experiments Show That Resistance Is Decreased 30 Per Cent by Increasing Width of Tires from 1½ Inches to 5 Inches

It has been recognized for many years that the narrow steel tire is enormously destructive to earth and gravel roads. The formation of a rut begins practically with the passage of the first vehicle improperly equipped, and though the users of such roads were aware of this fact and of its effect upon the usableness of the highway, they were slow to adopt the wider and seemingly clumsier equipment. The U. S. Department of Agriculture in Bulletin 72, from which the following has been abstracted, shows that the effort necessary to draw a certain load is an inverse function of the tire width, and in this manner forwards another argument against excessive load concentrations on the road surface.



GRAPH SHOWS UNIFORMITY OF TEST CONDITIONS

The final recommendations of the department are based, further, upon the weight per inch of width of the more common type of roller, it being felt that no load exceeding that at which the road was compacted should come upon it. An examination of many road rollers shows that the most frequently used weight is between 500 and 550 lb. per inch of width. The reasoning on this point is so elemental that it seems almost unnecessary to do more than call attention to the fact, yet the common type of farmer's wagon has tires so narrow that these rational figures are generally exceeded when the vehicle is loaded.

Tests Made Under Controlled Conditions

The accompanying curve is plotted from data obtained under similar conditions of moisture and atmosphere. The earth road was plowed, graded and rolled between each series of tests, and its condition throughout the investigation was probably as uniform as the nature of the test warranted. A gross wagon load of 5000 lb. was maintained, the tire width being varied from 1½ in. to 6 in.

The unit draft decreases directly as the weight per inch width of tire decreases, until a weight of 250 lb. per inch of tire is reached, as is indicated by the curve. The draft for a 6-in. tire is larger than that for a 5-in. tire. This was uniformly true, and indicates that there is not only nothing gained by increasing the width beyond a certain point, but there may be a positive disadvantage in so doing.

New Wagon Classification Suggested

The present method of designating wagons by the diameter of the skein is thought to be clumsy, and, as a substitute, the following is proposed:

Class	Load	Tire width
1-horse wagon	2,000	2
Light 2-horse wagon	3,500	2½
Medium 2-horse wagon	4,500	3
Standard 2-horse wagon	6,800	4
Heavy 2-horse wagon	7,500	5

The information as to carrying capacity should be stenciled on the rear axle. There are no definite recommendations that these limitations be incorporated in State legislation, but the inference is obvious.

Revolving Screens to Be Installed for New York Sewage

No Nuisance Is Expected from First Manhattan Island Unit of Sewage-Disposal Plan—Additional Plants to Be Built Later

A SEWAGE-SCREENING plant comprising two 14-ft. Reinsch-Wurl screens will be built in New York City this spring. The works will be the first ever constructed for the treatment of sewage on Manhattan Island. This plant is the forerunner of others that are to serve not only all of Manhattan but the other boroughs of Greater New York as well, although a small part of the sewage of two other boroughs is already being treated. Designed to screen 10,000,000 gal. per day during stormy weather and 5,000,000 gal. during dry-weather flow, the plant will treat the sewage that comes from only a small section of the borough, and which is at present being discharged without treatment into the Hudson River through the Dyckman Street outfall. According to Charles E. Gregory, engineer in charge of sewers, Borough of Manhattan, provision has been made for a future extension of the Dyckman Street system to provide for increased population in the tributary area.

Why Screens Were Chosen

Important factors in the selection of the type of plant were their small size and freedom from nuisance, as influenced by the high land values in New York, and by the close proximity of residential surroundings and a ferry terminal. An estimated ultimate dilution of 50 to 1 was considered ample to digest the impurities remaining in the effluent, provided sufficient solids were removed so as to prevent the accumulation of sludge banks. The dilution will be greater, due to the comparatively small quantity of sewage that will at first be treated at each of the many plants to be built at different points along the shore. It is planned to construct these other plants in the near future, although much will depend on the success of the Dyckman Street plant.

Serviceableness of Screens

An investigation showed that the Reinsch-Wurl screens not only would require less space than any other system of sewage disposal but would provide freedom from nuisance as well, and therefore would prove the most satisfactory in meeting local conditions. The somewhat disappointing result in per cent of solids removed reported from the experimental revolving screen installed at Cleveland, according to Mr. Gregory, was due to the high inflow head and the resultant swirling motion when the sewage passed onto the screens, thus causing clogging. In the New York screens the inflow head will be only from 3 to 6 in. The fresh condition in which the sewage will enter the plant also favors satisfactory operation, as the solids will not have become broken up and disintegrated by a long flow. A fact noted during the investigation was that the visible removal of a quantity of solids indicated the serviceableness of the screens, although a high percentage of removal of the finely divided particles was not expected. Experience in Dresden, Germany, covering several years, indicated the removal of a large percentage of suspended solids, but in New York it is expected that only from 20 to 30 per cent of the suspended solids will surely be removed, and that this will be sufficient to prevent formation of sludge banks, thereby relieving the condition in the vicinity of the present outfall where accumulations now exist.

NUISANCE TO BE AVOIDED

In order to make the plant as unobjectionable as possible, it will be washed down so as to prevent putrefaction, and the screens will be cleaned with washing soda and hot water. At first the screen accumulations are to be carried to sea by barges, but it is hoped that a process may be found whereby grease and other byproducts may be extracted from the screenings in paying quantities. Another plan is to send the screenings to garbage-disposal works.

The chief desire is to construct a plant which will prove as unobjectionable as possible to the community, and so the design as a whole has been made to conform with the proposed wide maritime way that is to extend to the future bulkhead line, while the building itself is of a type in harmony with the residential surroundings. The work is under the supervision of Borough President Marcus M. Marks.

With Simple Device Exact Wear of Concrete Pavements Is Measured

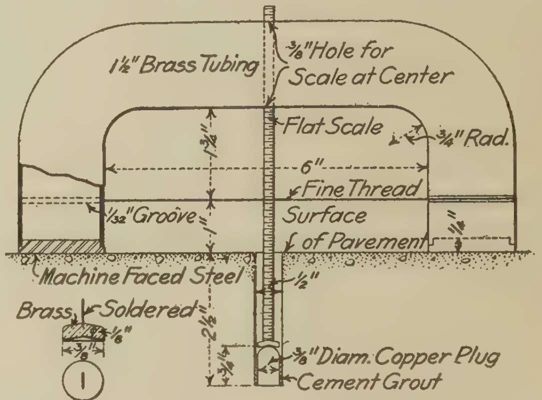
Copper Plug in Drill Hole Serves as Datum Upon Which End of Scale With Conical Base Rests

By A. N. JOHNSON
Consulting Highway Engineer, Portland Cement Association, Chicago

WITH the use of rigid types of pavements or pavements which rest upon a rigid base, the methods that had been devised for measuring the wear of macadam roads are open to considerable error, aside from usually being rather clumsy. Most of these devices provided for reference points at the sides. But where the pavement consists of a rigid slab or rests upon one, the observations that will be secured from a straight edge or wire stretched across the road are often quite useless, due to the movement of the slab and the possibility of its fracture because of unequal settlement. The method here proposed will overcome such difficulty and is also extremely simple and convenient.

COPPER PLUG IN DRILL HOLE

A drill hole ½ in. in diameter is made in the pavement. In the case of a concrete pavement it may be 2 or 2½ in. in depth. In the bottom of the drill hole is set a copper plug about ¾ in. long, with its top made semi-spherical. The plug is embedded in the hole with cement paste. A short steel scale divided into inches and hundreds, small enough to be placed in the drill hole, is provided. At its end is a small button with conical undersurface, which is to rest on the spherical end of the copper plug. Across the surface of the pavement bisecting the drill hole is stretched a fine thread, and measurements are made with the scale. The hole is then filled with a wood plug, left flush with the surface, which is to be removed when subsequent readings are to be made.



WITH THIS DEVICE WEAR OF CONCRETE CAN BE EASILY AND ACCURATELY MEASURED

A better, and probably more convenient, method would be to have a U-shaped handle, which will span about 6 in., having flat ends on the legs. Drawn between the supports is a tightly stretched thin thread or wire 1 in. from the surface of the pavement. This is to be held so that the thread will be over the center of the drill hole. The flat ends of the legs rest on the pavement surface and the measurements are made to the thread. The fact that the thread is raised above the pavement will make it possible to read the scale more conveniently, and is an easy method of holding the thread. The bridge or U-shaped handle holding the thread may first be placed longitudinally with respect to the pavement, then transversely, and in as many other positions as desired. The average of all readings is taken. The handle may be made of hard wood with metal-shod legs or of a bent hollow brass tube about 1½ in. in diameter.

This simple method will give, it is evident, data from which the exact wear at any point of the pavement is desired. A line of drill holes, spaced about 15 in. apart, at various places in the pavement, would give sufficient data to determine the variation in the wear at different points. In the case of concrete pavements these data would be of special value to determine what influence variations in the materials of the concrete had upon the wear. The accompanying sketch illustrates the apparatus.

Opinions on Catchbasin Cleaning Methods Differ

But Symposium of Sanitary Engineers Held in Boston Accents Value of Cleaning Rigs Mounted on Motor Trucks

TESTS with a catchbasin cleaning truck led George A. Carpenter, city engineer of Pawtucket, R. I., to announce a cost of 75 cents per cubic yard, based on an average load of 2.6 cu. yd. and a haul of 1¼ miles. He states that the outfit developed by him cleans the basins in a practical and rapid manner and at a cost much less than by manual methods. These facts were brought out in a symposium on "Catchbasin Construction and Maintenance," recently held before the sanitary section of the Boston Society of Civil Engineers, from which the following matter has been condensed.

The truck used by Mr. Carpenter was of 32 hp. and carried a steel body 9x4½x2½ ft., having a capacity of 3.4 cu. yd. Cover plates 2 ft. wide are placed over each end to prevent slopping. The loads have averaged 2.6 cu. yd., or about 3.4 tons. In the rear of the driver's seat is a 2 hp. gasoline engine which drives a cable running through an outrigger to an orange-peel bucket. The engine at present in use is insufficiently powered and will be replaced by one of 4 hp. Though oil has been used in the operation of the loading device, tests with compressed air have proved it very satisfactory, and it will be used in the future. The average loading time was 7 min. per cubic yard, and the speed to the dump a little over 7 miles per hour.

TRUCK'S MOTOR USED TO RAISE BODY

New York City has been using a somewhat similar outfit. Though based on Mr. Carpenter's design, the unique feature of the truck described by Charles E. Gregory, engineer-in-charge of sewers, Borough of Manhattan, is the use of the truck's motor in place of a special gasoline engine. The body has a capacity of 5¾ yd. and is filled by an orange-peel bucket 20 in. in diameter. This bucket is to be replaced by a heavier one, as difficulty has been experienced with it when hard material was encountered. The outfit is practical and a saving in maintenance has been realized.

The Otterson Auto-Eductor was described by Philip W. Taylor, who said that it had been used successfully in the West, cleaning the basins very easily and economically. Edgar S. Dorr, office engineer of the sewer-service department, Boston, Mass., stated, however, that the Otterson had proved unsuccessful at both Boston and Cambridge. John H. Gregory, of Hering & Gregory, New York, stated that his views were fully expressed in an article on "Hydraulic Ejectors for Grit Removal Merit Trial in Sewer Maintenance," published in the Engineering Record of Jan. 29, 1916.

INLET DESIGNS PROVE INTERESTING

According to L. M. Hastings, city engineer of Cambridge, Mass., one great disadvantage of any inlet grate is the likelihood of its clogging during a storm, which he states as the reason for having the throat in the curbstone. Where a basin is located in an unfavorable position, he has successfully tried the expedient of placing another grate about 10 ft. away with a connection to the regular basin.

In order to stop water flowing past gratings in hilly districts, Gordon H. Fernald, assistant engineer of the sewage-disposal commission, Fitchburg, Mass., has designed a grate having bars running obliquely to the line of the gutter, the back corner of each bar being ¼ in. lower than the front. The velocity of the water is diminished thereby and the flow diverted toward the gutter mouth.

FLANGED AND BOLTED TRAP SIMPLIFIES CLEANING

To let water off when the basin is plugged, it is only necessary to raise the flap on an outlet trap described by Mr. Dorr. The trap itself is detachable, the castings being flanged and bolted. Another trap design presented by William A. Brown, assistant engineer of the highway department, Providence, R. I., shows an iron basin placed beneath the invert of the outlet pipe. The sides rise to such a height that an iron hood, extending within the basin to a point below the invert of the pipe, forms a seal. Frank A. Marston, designing engineer for Metcalf & Eddy, Boston, comments on this design, stating that it is put out of service automatically when the sediment fills the trap. He adds, however, that the shape of the catchbasin permits water standing above the sediment to be bailed into the trap by the "bottom man," obviating the necessity of hoisting the water to the street surface.

A catchbasin designed to permit the water to seep away was shown by Mr. Carpenter. By using porous brick for the inner ring, water seeps through to a 2-in. collecting space between the two rings of brick and is carried away by a 4-in. drain leading to the sewer.

To lessen the trouble caused by street cleaners filling basins with refuse, Mr. Dorr described a catchbasin with a side inlet and having no opening over the catchbasin itself. The inlet is so arranged that not more than one or two bushels of refuse could be packed into the opening. In this connection Mr. Marston remarked that if the work of the various departments having in charge the design, construction and maintenance of basins could be under the general supervision of one official, much better conditions would prevail.

RÉSUMÉ SHOWS VALUE OF SYMPOSIUM

Mr. Marston epitomized the discussion as follows:

1. Where combined sewers or drains are laid on very flat grades, not providing self-cleaning velocities, catchbasins are useful to retain refuse in order that it may be removed more economically than from the sewers or drains.

2. A considerable saving in the cost of cleaning catchbasins can be effected by the use of a suitable motor-truck equipment.

3. Of the two examples of motor-truck apparatus described that developed by Mr. Carpenter appears to meet the conditions in New England cities where the Otterson machine, though successful in the West, has failed.

4. Where self-cleansing velocities can be obtained, inlets without traps should be built in preference to catchbasins, both for reasons of economy and better service. Furthermore, it may be more economical to construct a single catchbasin in the main drain at the head of a section laid on a very flat grade than to build catchbasins for a large number of surface connections.

5. Oil should be applied to the water in catchbasins to prevent the breeding of mosquitoes.

6. Catchbasins should be regularly inspected and, if necessary, should be cleaned after every severe storm.

7. Catchbasins should be built only where special conditions make them necessary, and not as a matter of routine, as appears to be the practice in some cities.

8. Unless catchbasins are actually catching grit, which would otherwise be deposited in the sewer or drain, they should be replaced by inlets.

Rods Hold Settling Concrete Road Together

With Ordinary Maintenance of Cracks, Pavement Is Not Seriously Impaired, Although Profile Presents a Series of Vertical Curves

By **H. B. BUSHNELL**

Division Engineer, Illinois State Highway Department

TWELFTH STREET in Cook County, Illinois, east of Hillside, presents a striking example of the settlement of a rigid pavement laid on a yielding subgrade. At this point the road extends through a slough for 600 ft., and though the maximum settlement at the time the last levels were taken was 1.74 ft. it is still in good condition. While a considerable number of small transverse cracks have developed, no longitudinal or diagonal cracks have appeared. The longitudinal reinforcement has kept the cracks from becoming large, and if these are given ordinary maintenance the utility of the road will not be seriously impaired.

OLD ROAD WAS OFTEN COVERED WITH WATER

Before the new construction was built with state aid, the slough was crossed by a 20-ft. waterbound macadam highway underlaid with corduroy. During the entire year the slough was covered with an average depth of water of from 2½ to 3 ft., which during periods of heavy rain rose sufficiently to overflow the old highway. Except at very great expense and considerable litigation, it seems impossible to effect perfect drainage.

Before the concrete road was laid, a large ditch, approximately a mile in length, was dug along the Illinois Central Railroad's right-of-way, effecting a reasonably good drainage into a small creek near by. The grade of the old road was raised about 2 ft. and a large culvert constructed under the road to carry off flood water and to equalize water depths on both sides of the road. This provided a large storage capacity which held the excess water until the level of the creek fell sufficiently to drain the slough. This has proved satisfactory, the slough being practically dry about nine months of the year.

The new grade was built up from strippings taken from a nearby stone quarry, the work being completed late in the season of 1914. Though the subgrade was thoroughly rolled and every effort made to compact the fill, it was impossible to secure a foundation that would not wave in front of the roller.

SETTLEMENT OF CENTER OF ROAD

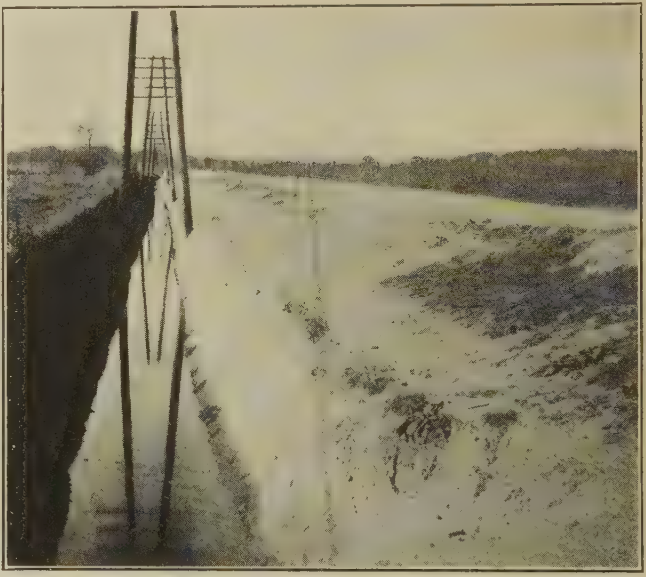
Station	Aug. 18, 1915—after 43 days	March 9, 1916—after 8 months	Nov. 17, 1916—after 16 months
155	0.02	0.00	0.01
156	0.00	0.00	+0.01
157	0.24	0.58	0.90
158	0.32	0.73	1.09
159	0.37	0.79	1.11
160	0.60	1.29	1.74
161	0.49	1.14	1.56
161+38	0.08	0.49	0.81

In July, 1915, an 18-ft. concrete pavement, especially designed for the conditions, was constructed across this section. The specifications called for a slab 10 in. thick at the center, 8 in. thick at the edges and reinforced with ½-in. square bars, 12 in. on centers in both directions, located mid-depth of the slab. All concrete was to be 1:2:3½.

Each day's work was squared up by a wooden bulkhead through which the reinforcing steel extended to furnish a definite bond with the next day's work. Since no so-called expansion joints were provided the entire length formed one continuous slab.

SETTLEMENT EXPECTED AND STUDIED

It was expected that the pavement would settle, and preparations were made to take level readings at definite times during construction and subsequently. Permanent benchmarks were placed near the ends of the road and stations marked on the concrete at every 100 ft. Levels were taken at each edge and at the center.



LARGE DITCH DRAINS SLOUGH NINE MONTHS OF YEAR

The accompanying table shows the settlements that have occurred. The sides settled practically the same as the center, and there was no appreciable settlement east of Section 155. The last station given is at the west end of the road.

Portland Cement Shipments Break Record

Shipments of Portland cement in the United States in 1916 approximated 94,508,000 bbl.—an increase over 1915 of more than 7,500,000 bbl., and the heaviest shipments in the history of the industry. Production, while it did not keep pace with shipments, reached a total of about 91,194,000 bbl., which is an increase of more than 5,000,000 bbl. over 1915. Stocks fell off more than 3,000,000 bbl., according to estimates by Ernest F. Burchard of the U. S. Geological Survey. Prices averaged higher and trade conditions were generally better than in 1915.

A. R. E. A. Committees Complete Another Year of Work

Abstracts of Reports Made to the Eighteenth Annual Convention of the Association, Which Was Held in Chicago This Week

[FOLLOWING OUR CUSTOM, *we here present a summary of the reports made by its committees to the American Railway Engineering Association, in convention in Chicago this week. These reports have been appearing in the association's bulletins during recent months. Comment is necessarily brief. Since this summary is prepared in advance of the convention it of course takes no account of action on the respective reports.* —EDITOR.]

Roadway

CONCLUSIONS recommended by the Committee on Roadway for adoption in the *Manual* have to do with width of berm under Class A track, with the desirable slopes for deep rock cuts and with the treatment of shrinkage in grading. The committee would retain its present standard berm for a depth of ballast of 12 in. or less below the ties, but would add to it for increased depth. Slopes of ¼:1 are recommended for rock cuts 40 ft. or more in height, the advantageous use of the cement gun for reinforcing bad rock on such slopes being pointed out. The committee thinks that little or no allowance in the height of a fill should be made to take care of shrinkage, unless the shrinkage of the material is well known in the conditions under which the fill is made. It recommends, however, an additional width of shoulder of from 10 to 22½ per cent of the height, according to the anticipated shrinkage.

The findings of the committee with reference to shrinkage are based largely on an extensive investigation made by a subcommittee. In the 30-page report of this subcommittee mechanical shovels, locomotive cranes and dragline excavators are considered, as well as shovel methods and operations and blank forms.

Another subcommittee presents a seven-page report on the relative advantages and disadvantages of elevation or depression of tracks or streets, as the case may be, in the elimination of grade crossings. While no recommendations for the *Manual* are made, the subcommittee favors track elevation in industrial districts and depression in residential districts, where there are too many crossings to permit the tracks to remain undisturbed. The subcommittee points out the value of traffic counts in the case of numerous streets, with the view to vacating certain of the crossings and constructing lateral streets in their stead.

No conclusions are reached as to the allowable unit pressures on roadbeds of different materials, or as to the prevention and cure of water pockets in roadbed, although in connection with the latter subject a subcommittee made inspection trips over parts of two railroads. (Bulletin 194.)

Ballast

Following further investigation of the relative values of ballast, the Committee on Ballast presents a slightly different order of effectiveness from that referred back to the committee at last year's convention. Broken slag (not granulated) is relegated to third place, a distinction being made between washed gravel, which is placed second, and pit-run gravel, which is placed fourth. Stone remains first and chatts, burnt clay or gumbo and cinders follow pit-run gravel. The committee recommends adding a "weathering test" to the approved test of stone for ballast, and will make further inquiry into this subject this year.

The committee presents outlines of the organization of various ballast gangs, and sees special merit in the New York Central method of raising track on stone ballast. No conclusions are reached as to mechanical tampers and other machinery, or as to ballasting by contract.

Another year's study has practically confirmed the conclusions of the committee relative to ballast sections, and the recommendation is renewed for the standard ballast section for Class A track with sub- and top-ballast. Before making more definite recommendations as to the absolute depth of ballast, however, or the proper ratio between depth of ballast and spacing of ties, the commission desires to await further tests to be made. (Bulletin 193.)

Ties

Study by the Committee on Ties of the effect of design of tieplates and track spikes on the durability of crossties included an inspection by a subcommittee of the abandoned line of the Delaware, Lackawanna & Western Railroad between Clark's Summit and Hallstead, Pa., and also examination of answers to questions submitted to a number of railroads. Five conclusions on the subject of tieplates are presented as information, the first being that the principal cause of failure to protect the tie has been insufficient area and thickness of the tieplate. The committee thinks it has not yet sufficient data to present conclusions as to the effect of fastenings on the life of ties, but is convinced that the use of cut spikes driven without boring holes not only hastens decay, but also seriously impairs the strength of the tie, and that a properly designed screw spike is the least destructive of any present form of fastening.

Two additional sentences are recommended for addition to the *Manual* specifications for crossties. They have to do with restrictions on inferior timber, in localities where ties deteriorate very rapidly.

The usual report on metal, composite and concrete ties contains 17 pages this year. (Bulletin 193.)

Rail

Only one recommendation for the *Manual* is made by the Committee on Rail. This covers a revision of one paragraph of the specifications for quenched carbon and quenched alloy-steel joint cars. The nearly 500 pages of the committee's report, including 9 appendices, testify, however, to the usual activity of the committee.

Included in the appendices are the usual statistics of rail failures for the year ended Oct. 31, 1915. The inferences drawn are similar to those of last year, that the number of failures of rails rolled in successive years since 1908 has decreased, and that the failures of Bessemer rails are far more numerous than those of open-hearth.

The other appendices include a discussion by George F. Comstock on segregated streaks in steel rails; by H. B. MacFarland on a test of rail joints; by Dr. P. H. Dudley on induced interior transverse fissures; by W. C. Cushing on an improvement in the method of casting ingots and on the quick-bend test as a substitute for the drop test; and by M. H. Wickhorst on transverse fissure, rail 51,051, on transverse fissure rails on the Louisville & Nashville Railroad, and on the rail-failure situation.

The committee at large also reports progress on its investigation of track bolts and nutlocks, of details of manufacture and mill practice of rails, of joint bars and of other subjects assigned to it. (Bulletins 188 and 195.)

Track

Twelve subjects were assigned for the year's work to the Committee on Track. The committee offers for adoption in the *Manual* designs for cut spikes, screw spikes and screw spike testing gages, a definition of main track and a slight revision in the *Manual*. It offers as information seven pages relative to the design of and specifications for manganese frogs and crossings, together with drawings illustrating them.

Progress is reported in the study of the economics of track labor and the committee presents conclusions it has reached as to the best manner of continuing the work. Progress is also reported on the test of tie-plates subject to brine drippings. In the matter of reducing the present allowable limit for flat spots on freight-car wheels, the committee states that it has been in touch with the president of the Master Car Builders' Association, who advised that the executive committee of that association is opposed to such a reduction. The committee, however, thinks the reduction as a reasonable proposition, would not involve considerable expense and should be given more consideration. As to the limit of wear on the railhead and curve, the committee thinks no rule can be given and each road must decide the question. As to the extent to which the committee's frog and switch designs are being used by the railways, the committee has found that many roads are using them on new work, but thinks it is not practical to make frequent changes in previously adopted standards for general maintenance work.

Progress only is reported as to specifications for relayer rail for various purposes, and more time is sought to report on typical plans of turnouts, crossovers, slip switches and double crossovers and prepare detailed plans for such work, and also to report on reduction of taper of tread of wheel to 1 in 38 and on canting the rail inward. The committee believes it should be relieved, however, of further consideration of the effect of increasing the thickness of wheel flanges, as the wheel committee of the Master Car Builders' Association has concluded that this would accomplish nothing. (Bulletin 193.)

Buildings

The Committee on Buildings concentrated its efforts during the last year on the two subjects of ashpits and freight-house scales. As a result, it offers for adoption in the *Manual* a page covering the latter subject and three pages covering the former. No other recommendations are made, except a revision of the *Manual*, under the item engine houses, similar to that made last year. (Bulletin 194.)

Wooden Bridges and Trestles

A six-page discussion of the comparative merits of ballast-deck and reinforced-concrete trestles, with two short appendices giving formulas and tables of justifiable expenditures, forms part of the report of the Committee on Wooden Bridges and Trestles. The committee concludes, however, that the relative advantages are not susceptible to mathematical demonstration and that each case should be settled on its own merits.

The desirability of galvanized-iron fastenings for timber trestles was also investigated, and the committee presents in a seven-page appendix information received from various companies and individuals. The committee's conclusions indicate that it doubts the need for galvanized fastenings.

Progress is reported in the classification of wooden bridges, and in the investigation of the use of lag-screws for fastening guard timbers. The use of lag-screws by fifteen railroads is presented in a table, but the committee asks more time before making final recommendations. (Bulletin 193.)

Masonry

Recommendations for the *Manual* on four distinct subjects testify to the activity of the Committee on Masonry. The subjects are concrete piles, surface finishes of concrete, nomenclature and formulas for retaining walls and specifications for cement—Portland and natural. The committee presents for adoption specifications for constructing and for driving precast concrete piles. It also offers for adoption a page of information regarding cast-in-place piles.

As suggested at last year's convention, the specifications for surface finishes of concrete have been edited to eliminate the purely descriptive matter, and are recommended for adoption. The committee also recommends the acceptance of five general conclusions, which embrace those of a year ago, and in addition points to the desirability of rubbed margins and outlines, and urges the necessity for careful formwork and placing of the concrete. A number of illustrations of pleasing surfaces are presented.

Twenty-six pages on the principles of design of plain and reinforced retaining walls and abutments include a large number of drawings of the standards of various railroads, nomenclature and formulas for retaining-wall design and an enumeration of nine principles to be observed.

The specifications for cement are to replace those now in the *Manual*. They are the result of the joint efforts of representatives of the numerous organizations that have been studying the question. (Bulletin 194.)

Signs, Fences and Crossings

Responding to the criticism at last year's convention of the plans submitted by the Committee on Signs, Fences and Crossings to cover track construction and flangeways at paved street crossings and in paved streets, the committee has gone into the subject further. It has not, however, found it advisable to revise the plan previously submitted. It states why at some length. It also presents a table of flangeway practice for 104 railroads.

As information, the committee presents a discussion of signs, the substance of which is that railroads use too many, and that more attention should be given to their design and location and to the securing of observance of them.

Considerable additional information on the subject of concrete and steel fence posts has been assembled by the committee and is presented.

Abstracts of laws relating to the providing of right-of-way fences and the installation of stock guards in the various states and in Canada occupy 22 pages.

The remaining subject assigned to the committee was a comprehensive study of grade crossings and their elimination. Because the committee had so much other work in hand and because a committee of the American Railway Association is working on the same subject, it has not attempted to make an extensive report this year. It has, however, assembled considerable information, which it presents. (Bulletin 192.)

Signals and Interlocking

A feature of the report of the Committee on Signals and Interlocking is a continuation of the technical analysis of the capacity of single track, begun in the report of last year. The second installment takes into account trains of different classes, and shows the great effect on freight-train capacity of the number and position of passenger trains. The length of the discussion precludes its presentation in this journal. Another feature is a 50-page analysis of the signal schemes which have been presented to the association.

In addition to these two extended discussions, the committee recommends for adoption a list of requisites of switch indicators, and reports progress in various other investigations assigned to it. (Bulletin 192.)

Records and Accounts

Numerous changes in the *Manual* are proposed by the Committee on Records and Accounts. They have to do with definitions, forms, track maps and charts and conventional signs.

Specifications for maps and profiles, conforming to the requirements of the government's Division of Valuation, are recommended for adoption, as are a large number of valuation forms assembled for field and office use.

The committee was instructed to report on any desirable changes in the Interstate Commerce Commission's classifications of accounts covering road and equipment and operating expenses. The committee holds that while minor improvements could be made, frequent changes are undesirable. It does, however, offer suggestions to serve as a basis or guide when the railways and the commission are ready and desirous of reviewing the various classifications. (Bulletin 194.)

Rules and Organization

The main work of the Committee on Rules and Organization has been the completion and classification of its investigation of clearances. The committee offers for insertion in the *Manual* the main conclusions proposed last year; minimum clearances to specific structures (for new construction) somewhat less than those objected to at the convention last year; the nine exceptions presented last year, and a new clearance diagram based on the action of the convention last year. [The diagram prepared by the Engineering Record and published in its issue of April 1, 1916, page 446, following the action of the 1916 convention, accords with that of the association, except that the latter gives qualifying requirements for curves of less than 800-ft. radius.]

Aside from its work on the clearance diagram, the committee reports progress in its investigation of instructions for the guidance of engineering field parties and for the employees of the maintenance-of-way department, and in its study of the science of organization. (Bulletin 195.)

Water Service

Except for a number of extensive revisions of the *Manual* to make the language clearer, the Committee on Water Service merely reports progress and presents information. The information, however, embraces discussions of methods for rejuvenating driven wells and their cost and success as compared with driving new wells; a report on various types of well strainers, and the use of and service secured from each type; one on methods for complying with federal regulations in regard to purity of drinking water, one on the relative merits of continuous and intermittent water softeners, and one on rules or examination questions for care of boilers in pumping stations. (Bulletin 193.)

Yards and Terminals

Three hump profiles—one for cold climates, one for moderate and one for warm climates—are recommended for adoption by the Committee on Yards and Terminals. These would replace the profile now in the *Manual*, which the committee desires to have stricken out. The committee would also strike out the sentence in the *Manual* allowing a grade of 2 per cent over track scales, substituting a provision that it should not exceed 1 per cent and should preferably be not less than 0.6 per cent. Considerable data obtained from various roads regarding humps and ladder types are presented as information. Drawings of twenty-seven ladder types show about every conceivable design, from the simplest involving a small number of tracks to the most complex where a quick spread to a large number of tracks is desired or where double ladders are used. They apply to both freight switching yards and passenger terminals.

Track-scale specifications similar in all respects to those that will be recommended for adoption by a committee of the American Railway Association are presented as information, as are data regarding nine double-deck freight houses. There is also a three-page appendix on the handling of L. C. L. freight by tractors and trailer trucks—Chicago Junction Railway. (Bulletin 194.)

Iron and Steel Structures

An account of impact tests made on the Norfolk & Western Railway during the summer of 1916 constitutes a large part of the report of the Committee on Iron and Steel Structures. The committee submits for adoption a substitute for the impact formula now in the *Manual*, the new formula being $I = 30{,}000/(30{,}000 + L^2)$.

A five-page progress report on present practice in the construction of ballast-floor bridges and methods in use for waterproofing them is presented without recommendations. A shorter report on methods of protecting iron and steel structures against corrosion is offered and a paragraph designating chilled cast-iron plates as the best form of protection to steelwork from locomotive blasts, and explaining how they should be placed, is recommended for insertion in the *Manual*. (Bulletin 195.)

Economics of Railway Location

Progress only is reported by the committee on economics of railway location, except in the matter of revision of the *Manual*. A number of changes are recommended for the *Manual*, these being chiefly condensing of the text. The committee recommends also a division of its matter under certain heads when the next *Manual* is issued.

An appendix by Prof. Edward C. Schmidt discusses the test of passenger-train resistance made last summer on the Illinois Central Railroad. (Bulletin 194.)

Wood Preservation

Specifications for creosote oil analyses, substituted for those now in the *Manual*, are recommended by the Committee on Wood Preservation. These have been prepared in co-operation with the committees of the American Society for Testing Materials and the American Wood Preservers' Association. No radical change has been made, but the committee believes it has made the specifications more precise and explicit, and it has also added a number of new features.

As a result of the continued investigation of water sampling in creosote oil, the committee recommends for adoption a clause to the effect that the principles of zone sampling be employed, using a type of apparatus shown.

Progress reports are made on exposure tests of ties treated with water-gas tar and on records of service tests. (Bulletin 195.)

Electricity

Fourteen additional definitions are recommended for the *Manual* by the Committee on Electricity. Aside from these, the committee reports progress only. Its report gives evidence, however, of considerable work. It has checked up the question of clearances and has seen that its diagram does not clash with that of the larger diagram presented by the Committee on Rules and Organization. It presents considerable tabulated data regarding overhead clearances. It has also been collecting photographs, blueprints and other data, some of which it presents, relative to transmission lines and crossings. A 12-page progress report on maintenance organization and the relation to track structures is also supplemented by numerous illustrations.

In connection with the question of electrolysis, it has had published with its report the preliminary report of the American Committee on Electrolysis, on which it is represented. This report contains 152 pages. An introductory paragraph explains that it is intended to include only statements of fact, and that it does not attempt to draw conclusions, make recommendations or discuss questions of law. (Bulletin 191.)

Conservation of Natural Resources

A 26-page progress report by the Committee on Conservation of Natural Resources covers a wide range of topics, such as the conservation of timber, future metal supplies, coal wastes, smoke prevention, the use of pulverized coal and the question of water power or coal. Considerable space is given to the progress of conservation in Canada. A new feature of the report, suggested at last year's convention, is the inclusion of the conservation of human life and the discussion of safety-first movements. (Bulletin 193.)

Uniform General Contract Forms

Acting on several criticisms received by the special Committee on Uniform General Contract Forms of its blank agreement for industrial track submitted last year, the committee has revised the agreement, and recommends it for adoption.

Progress is reported on the other subjects assigned to the committee. (Bulletin 194.)

Grading of Lumber

Last year the special Committee on Grading of Lumber presented tentative specifications for Southern yellow-pine bridge and trestle timbers to be treated. With slight changes, the committee now recommends them for adoption in the *Manual*.

The principal subject assigned to the committee was to "draw up in unified form a second specification for construction timbers and building lumber for use on railways, showing each kind of quality of lumber or timber which was suitable for each of the different classes of work on a railway." This year, the committee has confined its work to establishing a broad general classification as to uses. This it submits as a progress report, asking for criticism.

The committee also reports that it has given considerable attention, in co-operation with the corresponding committee of the American Society for Testing Materials, to the desirability of formulating a density rule for Douglas fir similar to that adopted last year for yellow pine. (Bulletin 194.)

Stresses in Railroad Track

A brief progress report, similar to that presented at the January meeting of the American Society of Civil Engineers, is presented by the special Committee on Stresses in Track. Besides various tests of the apparatus itself, field tests were made during 1916 on 85, 125 and 136-lb. sections of main line of the Illinois Central Railroad with Mikado, Pacific & Atlantic types of locomotives running at various speeds. Tests were also made on the Delaware, Lackawanna & Western Railroad with four types of locomotives on 105-lb. rail. In addition to the strains in the rail, track depressions were measured. Static tests were made to determine the bending in ties and stresses in track.

Laboratory tests on the distribution of pressure downward through ballast material have been carried on. Apparatus has been installed and tests have been made with stone ballast, gravel ballast and sand, using different depths of material and loads up to 50,000 lb. The work of reducing all test data has been carried on and the material is being put into satisfactory form for final record. (Bulletin 193.)

Cast 25-Ton Concrete Blocks for 38½ Cents a Yard

Three Half-Yard Mixers Mounted on Moving Platform and Supplied by Crane Pour 1242 Yards in 11½ Hours at Panama

By R. Z. KIRKPATRICK
Formerly Assistant Chief Hydrographer, Panama Canal

MOUNTED on a pair of flat cars running parallel to the casting yard and at sufficient height to deliver concrete by gravity, three ½-yd. mixers, supplied with material from a stock-pile trestle in the rear by a locomotive crane, made good records both for speed and for cost in concreting 25-ton blocks used for armoring the east breakwater in Limon Bay, Canal Zone. This breakwater, at the northern terminus of the canal, contains 682,000 cu. yd. of core rock and 67,500 cu. yd. of armor rock, in addition to a large yardage of 5.6, 10.6, 18 and 25-ton concrete blocks. All except the largest of these were made, and all were placed, by the canal organization. They were plowed off on the sea slope from Lidgerwood cars for the most part, the top sections being placed by derrick barges. The blocks were embedded in a small amount of soft rock, serving the purpose of cushion material.

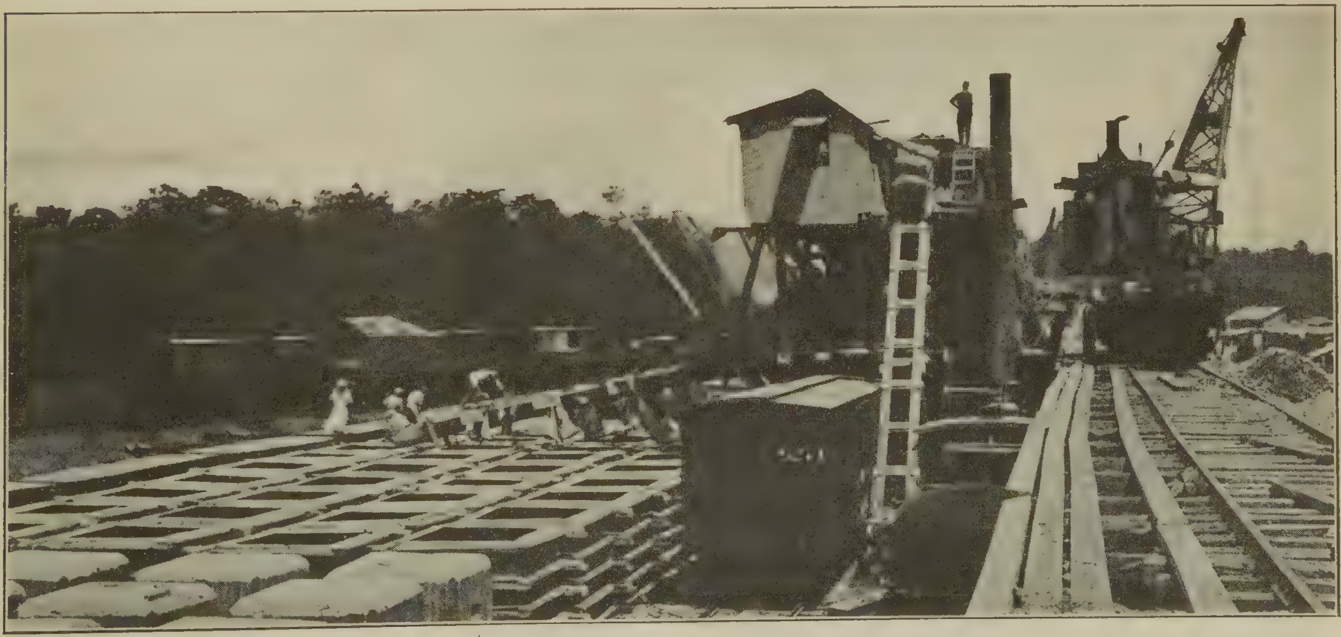
LARGEST BLOCKS MADE UNDER CONTRACT

The 25-ton blocks, which are 7-ft. cubes and contain 12.3 yd. of concrete each, were manufactured under contract. The canal organization furnished gravel and cement delivered, and also supplied free use of second-hand material and equipment for the contractor's plant. The first 1500 blocks were made with 1 part of cement and 6 parts of run-of-bank Chagres River gravel. The remaining 10,500 blocks were made of 1 to 4½ concrete. In all, 12,000 blocks containing 147,600 yd. of concrete were made under this contract at $14.7355 per block, or 38½ cents per yard. On one occasion 101 blocks containing 1242 yd. were cast in 11½ hours, representing an average hourly output of 108 yd. for the plant, or 36 yd. for each mixer.

PLANT MOUNTED ON FLAT CARS HAD CHUTE DELIVERY

The three mixers were mounted on a platform erected on two flat cars running on parallel tracks 14 ft. apart. In front of these tracks was the casting yard, about 50 ft. wide, beyond which were the loading and switching tracks and the storage yard. Behind the mixer tracks was an elevated trestle from which gravel was dumped into stock piles. The mixers were mounted high enough to enable them to chute concrete directly into the farthest forms, 40 ft. away. They were supplied by gravity from a 6-yd. hopper, which was kept full by a locomotive crane with a clamshell bucket. The crane ran on the stock-pile trestle 12 ft. behind the outside mixer track and 14 ft. above it.

Material was drawn from the hopper into a small measuring hopper through a sliding gate, the cement was added, and the batch discharged into the proper mixer through a system of sliding doors. Cement was received in box cars and raised to the mixer platform by Decauville cars, one of which at each end of the plant was operated on an inclined track by a hoist. Each elevator had a capacity of 10 sacks of cement a minute.

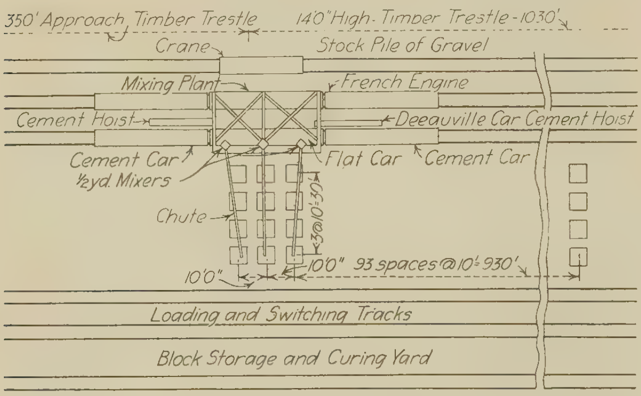


LONG, NARROW YARD WORKED IN ALTERNATE SECTIONS TO REDUCE FORM TRAVEL

The driving power for the entire plant was obtained from an old French locomotive which was coupled to the outside flat car and also used to shift the plant up and down the yard as required. The mixing yard was laid out in rectangular plan, with four rows of casting platforms parallel to the mixer tracks. Each 12-file section was grouped into a rectangle containing 48 blocks, with passageways between them for workmen. In pouring, every other rectangle of 48 was left, so as to permit the forms to be shifted with the least travel. Although 394 bases were required, only 180 sets of forms were used. These were stripped in 24 hours if necessary, and the blocks lifted from their bases and moved to the curing and storage yard in 72 to 96 hours.

FORMS MADE IN TWO PIECES

The bases were 9 ft. square and made of ⅞-in. lumber. The side forms, 7 ft. square inside, were made of the same size lumber and provided with bevel strips at all edges. Two adjacent sides were nailed together solid, so that the complete side form for each block was handled in two pieces. In dismantling, wedge blocks, placed at the outside clamp pieces, made it easy to take down and move out a half form. Recesses on two opposite faces were cast in each block for handling. The blocks were lifted by a 40-ton Industrial Works crane using especially designed hooks weighing 2600 lb.



THREE MIXERS, RUN CONTINUOUSLY, SUPPLIED FROM SINGLE BIN

West Indian labor, managed by American foremen, was employed throughout the work. This labor is now quite efficient because of its long experience on the canal. The contractors for these blocks were Walker & Torbert, formerly superintendent and chief clerk respectively of Pacific terminal construction.

Cost of Catchbasin Cleaning

The average cost of cleaning city basins, including the cost of labor and team haul, for the District of Columbia during the year ended June 30, 1916, was $0.297 per basin, the cost per ton of silt removed being $2.15. For suburban basins the average cost of cleaning was $0.565 per basin and $0.859 per cubic yard for material removed. The cost of loading the material on scows, water transportation, unloading, and grading was $0.925 per ton. A total of 10,914 cu. ft. of material was removed from sewers and 71,500 cu. ft. from the settling chamber of the disposal works, while 804,866 lb. of screenings was removed and incinerated. These figures are from the annual report of the Engineer Department.

Record Production of Lime in 1916, Says Geological Survey

Sale of Hydrated Lime Increases—Prices of Lime Higher—Bigger Demand Partly Offset by Higher Production Cost

LIME produced and sold in 1916 in the United States, including Porto Rico and Hawaii, indicates a total marketed production of 4,150,000 short tons. This is a gain of nearly 15 per cent over the total for 1915, which was 3,622,810 short tons, according to an estimate just made by G. F. Loughlin of the U. S. Geological Survey. This is also the first year in which the production of lime in this country has exceeded 4,000,000 tons.

Of the 43 states in which lime was produced and sold, 31 reported increases. The remaining states represented less than 6 per cent of the total quantity produced. The only states with outputs of more than 50,000 tons that showed decreases in 1916 were Michigan, which produced 80,000 tons, and Illinois, which produced 74,000 tons. Washington produced 25,000 tons—a decrease of 8 per cent over 1915. The estimated outputs of the states with a marketed production of more than 100,000 short tons are shown in the accompanying table.

Hydrated lime in 1916 showed an even more striking increase than total lime. The marketed production amounted to 710,000 tons, which is a gain of more than 13 per cent. All states in which the production amounted to 5000 tons or more showed increases. These included Michigan, Illinois and Washington, in which the total production of lime decreased.

ESTIMATED LIME PRODUCTION OF LEADING STATES IN 1916

	TOTAL LIME		HYDRATED LIME	
State	Tons	Per cent of gain	Tons	Per cent of gain
Pennsylvania	1,037,000	15	113,000	45
Ohio	529,000	4	339,000	8
Virginia	350,000	32	*	89
West Virginia	310,000	24	51,500	37
Wisconsin	259,000	17	*	20
Missouri	204,000	31	34,971	66
Maryland	168,000	29	31,500	65
Maine	152,455	11	*	34
Massachusetts	139,000	3	*	10
New York	124,000	7	7,000	190
Indiana	120,000	20	24,600	39
Tennessee	120,000	45	*	50

*Figures not disclosed, as less than three companies produced hydrated lime.

Prices of lime were generally higher in 1916 than in 1915, though in some places the increase was not great until the close of the year. Companies giving more specific information reported an increase in price of 8 to 20 per cent, or 25 to 60 cents a ton, over the average prices in their respective states in 1915. Business conditions were reported to be improved by a majority of companies and were called abnormally good by a few; but in some states the increased demand for lime was largely offset by the increased cost of production.

The Story of Imperial Valley Told in Moving Pictures

A moving-picture producing company of southern California is now preparing a feature film on Harold Bell Wright's book, "The Winning of Barbara Worth." The reels are to tell the true story of the conception of the great irrigation enterprise and the difficulties which attended the early stages of the development.

Standard Highway-Bridge Plans Used on County-Road System

Overflow Bridges Meet Unusual Conditions at Low Cost—I-Beams and Box Culverts Predominate—Little Structural Steel Used

By WILLIAM C. DAVIDSON
Waco, Texas

INCASED I-BEAM OVERFLOW BRIDGE REPLACES STRUCTURAL STEEL SPAN ON REALIGNMENT

STRUCTURAL STEEL SPAN WITH CONCRETE FLOOR TO CARRY HEAVY TRAFFIC ON A MAIN ROAD

IN the construction of the 488 bridges and culverts necessitated by the requirements of the McLennan County, Texas, highway system the methods of location and design were reduced to a minimum and standardized plans were used wherever possible. Of the total issue for roads and bridges amounting to $1,075,000, approximately $180,000 was expended on the bridges and culverts of the system.

With the exception of the larger structures and where conditions required special study, construction stakes for bridge or culvert work were set at the time the alignment of the road was being run. Grades having been determined from preliminary surveys, locating stakes were set with reference to this datum, usually one on either side of the road along the fence line where they were not disturbed by traffic. The line established by these stakes located the center line of the opening and information as to the distance to the center of the culvert and the distance from the top of the stake to the top of the top slab was marked on the stake. This procedure had to be modified with the more elaborate structures, such as the I-beam bridges and overflow culverts, but in general the contractor could secure enough information from the data given to allow him to locate the structure properly.

HOW SIZES OF OPENINGS WERE DETERMINED

From an inspection of the existing openings, if any, and from approximate estimates of the size of the drainage area, the size of the waterway required was determined. In many cases the watershed was so small that it was not a difficult matter, but in some instances the watershed covered so large a territory that its approximate area could not be determined from a casual inspection. Where the culverts to be built were small, no ravine sections were taken, but in all cases the distance from the grade to the flow line of the stream was determined. With blueprints made from standardized drawings, and with data of this simplicity, it was only a question of minutes to prepare four copies of a plan for the opening. However, where the channel was large, requiring the use of an I-beam structure of one or more spans, and a ravine section had been taken, the data were plotted on profile paper in the office to assist in determining the height of piers. Where the channel was wide enough to require more than two spans, a special design was made, giving due regard to expansion joints and height of abutments and piers.

On stretches of road subject to overflow, where it was impracticable to try to construct an economical span, considerable time was spent in investigation and study. In some cases a special design was adopted, but usually a modification of the I-beam construction or of the concrete culvert was possible, which would allow inundation of the floor system during periods of extreme high water. Since all overflow bridges were built in connection with a stretch of concrete road on each side, this road extending to the edge of the overflow area, it was important that the high-water mark should be determined with reasonable accuracy.

TABLES SUPPLEMENT STANDARD DRAWINGS

Tables showing all dimensions for a culvert of a certain length, height and width of roadway were prepared, which gave the size, length and spacing of longitudinal and transverse steel, and the approximate quantities of concrete. These quantities were used for estimating purposes only, final payments being made upon actual quantities. Other tables were prepared for the I-beam bridges, and these, of necessity, went more into detail, giving approximate quantities of concrete in the substructure as well.

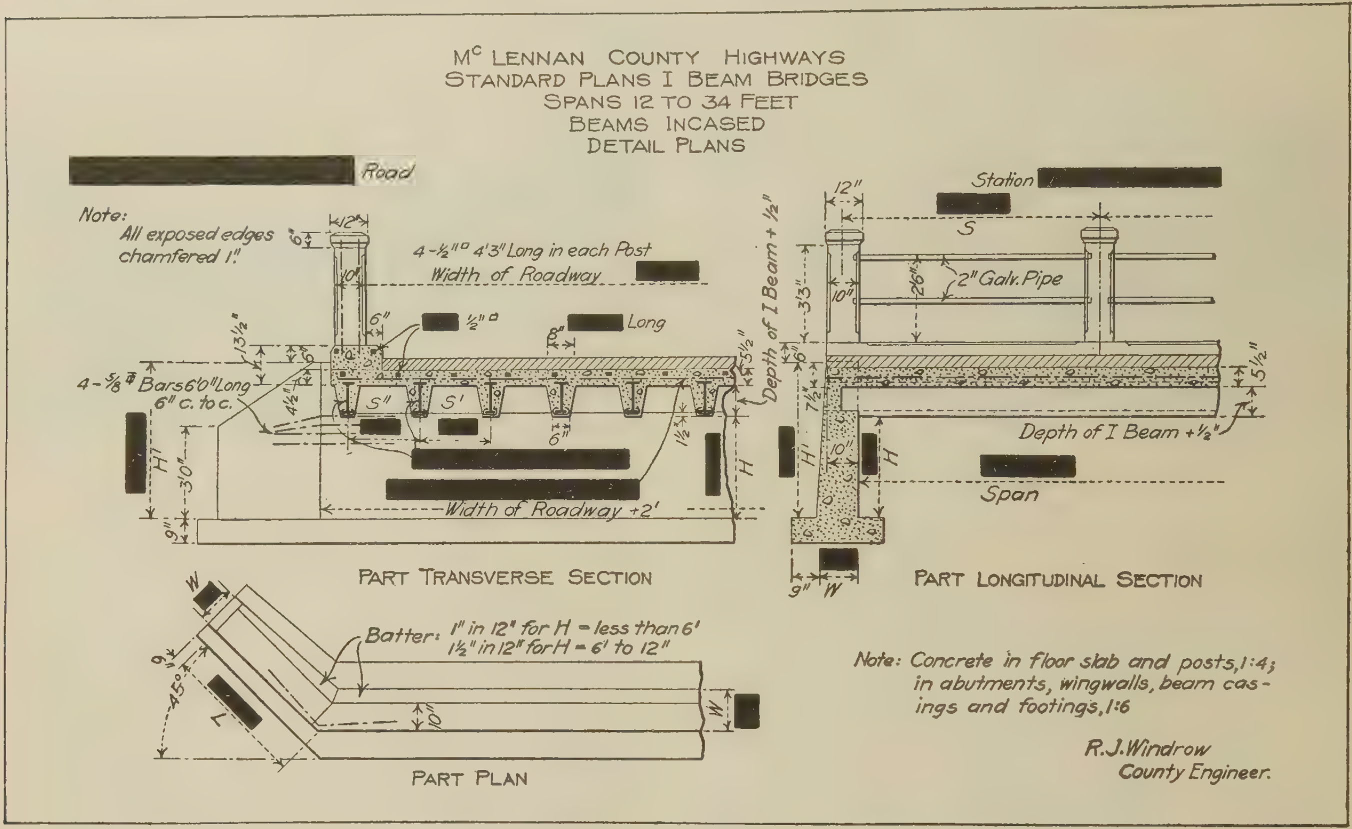
These standards covered both single and double openings, and the double-opening design was frequently used in series by simply noting the number of openings desired. Only a few dimensions of these bridges and culverts were standard, spaces being left for writing in all other data and dimensions. The plans and tables for the box culverts called for spans ranging from 3 to 16 ft. and for the I-beam construction for spans from 12 to 34 ft.

Class of Road Affects Design Used

Four general types of bridges and culverts were used on this work—reinforced-concrete boxes, steel I-beam bridges, structural steel bridges and pipe culverts. The latter consisted of corrugated and vitrified pipe, depending on the class of road upon which it was used. Overflow bridges used in certain places involved the use of two general standards, and of special designs where standard drawings could not be employed.

Except in the case of overflow bridges, where the width of roadway corresponded with the width of road—16 ft.—practically all box culverts were built for roadways of 20 and 24 ft., the former being used on second-class and the latter on first-class roads. The height of box culverts varied from 18 in. to 6 ft., and when a greater height than this was necessary an I-beam span was built on account of its greater economy.

Retaining walls were made vertical on the face and battered 2 in. in 1 ft. on the back side, and abutments were made vertical on the face and battered 1 in. in 1 ft. on the back. No attempt was made to obtain rock foundations for culverts of this nature, a firm clay or earth being considered satisfactory foundation material, since the bottoms of all culverts were paved with concrete and toe walls were used to prevent under wash of the footings and bottom slab. Only the top, or floor, slab



Mc Lennan County Highways
Standard Plans I Beam Bridges
Spans 12 to 34 Feet
Roadway 24 Feet
Dimensions and Quantities

Superstructure															
	Steel Joists									Slab and Posts				Rail	
	Beams Exposed				Beams Encased					S	Reinforcement		Concr. (No.1)		
Span.	No. and Size	Wt.	S'	S"	No. and Size	Wt.	Concr. (No.2)	S'	S"		No. and Size	Wt.		No. and Length	Lin. Ft.
12	2-6"[s 9-6"Is 13'8"	1730	30"	30"	2-6"[s 9-6"Is 13'8"	1730	1.68	30"	30"	12'10"	16 ½"□ 4'3" 22 " 26'6" 18 " 13'6"	596	6.84	4 pcs @ 12'6"	50
15	2-7"[s 9-7"Is 16'8"	2580	30"	30"	2-8"[s 9-8"Is 16'8"	3081	2.64	30"	30"	7'11"	24 " 4'3" 25 " 26'6" 18 " 16'6"	708	8.44	8 pcs @ 7'6"	60
34	2-15"[s 9-15"Is 35'8"	15851	30"	30"	2-15"[s 10-15"Is 35'8"	17350	11.62	27"	28½"	8'8½"	40 " 4'3" 53 " 26'6" 18 " 35'6"	1476	17.79	16 pcs @ 8'3"	132

Note: The beams in the table above were designed for a dead load of the weight of slab a 3" of road material plus a live load of 100 lbs. per sq. ft.

Substructure							
Abutments			Wingwalls				
H	W	Concr. (No.2)	L	*H'	W'		Concr. (No 2)
4'	15¾"	14.42	5'8"	5'8"	13"		4.87
5'	16¾"	17.46	7'10"	6'8"	13"		7.20
12'	30½"	46.10	22'8"	13'6"	14½"		33.9

*Note: These values of H' are calculated assuming a beam depth of 12". When depth of beam differs from this, increase or decrease H', W, and L proportionately.

R.J. Windrow
County Engineer

STANDARDIZED DRAWINGS AND REFERENCE TABLES MAKE THE DESIGNING OF BRIDGES AND CULVERTS A MATTER OF MINUTES of the culvert was constructed of reinforced concrete.

The use of I-beam bridges was based on consideration of economy only. The width of roadway over structures of this type was varied to accord with the demands of traffic, usually being 20 ft. wide on first-class roads and 16 ft. on second-class roads, though these widths were not adopted as an absolute standard and some deviation was made from them. Except in the case of overflow structures, this type of bridge was provided with gas-pipe handrailing embedded in concrete posts. All footings were either extended to solid rock or to a firm clay or earth about 2 or 3 ft. below the flow line of the channel, and all walls were built at an angle of 45 deg. with the axis of the culvert. The I-beams were incased in concrete with wire mesh placed around the lower flange, and the floor slab was reinforced with longitudinal and transverse rods.

Only a few structural steel bridges were used on the system, and most of these were built under direct supervision of the county engineer. All except one were built with wood floors and wood floor joists, the one exception being constructed with a concrete floor of 18 ft. width as against the 12 and 16-ft. roadways of the remainder. All such bridges were placed on reinforced-concrete piers and approaches were built of piling set on footings of concrete. This type of construction obtained only over the larger streams, where the shorter span I-beam design was not economical.

BOX CULVERT OF 16-FOOT SPAN TO MEET OVERFLOW CONDITIONS

Factors Affecting Design of Overflow Bridges

Both the incased I-beam bridges and concrete box culverts were used where the terrain indicated overflow conditions. In general, the design followed closely that of the basic type, with the exception that only a very low railing wall was provided. The railing was made low and massive, or eliminated entirely, to afford a minimum of resistance to the flow of water, thereby entailing less danger from the lodging of drift. Besides this detail, and the fact that all beams are firmly anchored to the abutments by reinforcing rods, all other features of design are identical with the general I-beam bridges and box culverts previously described.

All work on the McLennan County Highway System, including that on the bridges and culverts described in this article, was done under the direction of Rollen J. Windrow, county engineer of Waco, Tex., with J. M. Isbell and the writer as assistant engineers. With the exception of a few structural steel bridges built under the direct supervision of the county engineer, the work was done under contract by the McCall-Moore Engineering Company, of Waco, Tex., and the Richard Morey Construction Company, of St. Louis, Mo.

Graphical Analysis of Complex Reinforced-Concrete Beams

Sections with Steel in Various Locations Can Be Treated Graphically—Method Applied to Investigations and Design

By W. S. WOLFE
Instructor in Architectural Engineering, University of Illinois

APPLICATION of graphical methods to the location of the neutral axis and the determination of effective depth and resisting moment of reinforced-concrete beams is here proposed for cases of complex sections where the steel is distributed as in beams reinforced for compression or where several layers of rods are used. It is assumed that graphical methods are familiar to the reader, and these methods will be illustrated both for investigating a given section and for designing a section to resist a given bending moment.

[Another article, treating the reinforced-concrete beam by analytical methods, written by J. H. Cissel, is printed on page 457.—Editor.]

To Find the Neutral Axis

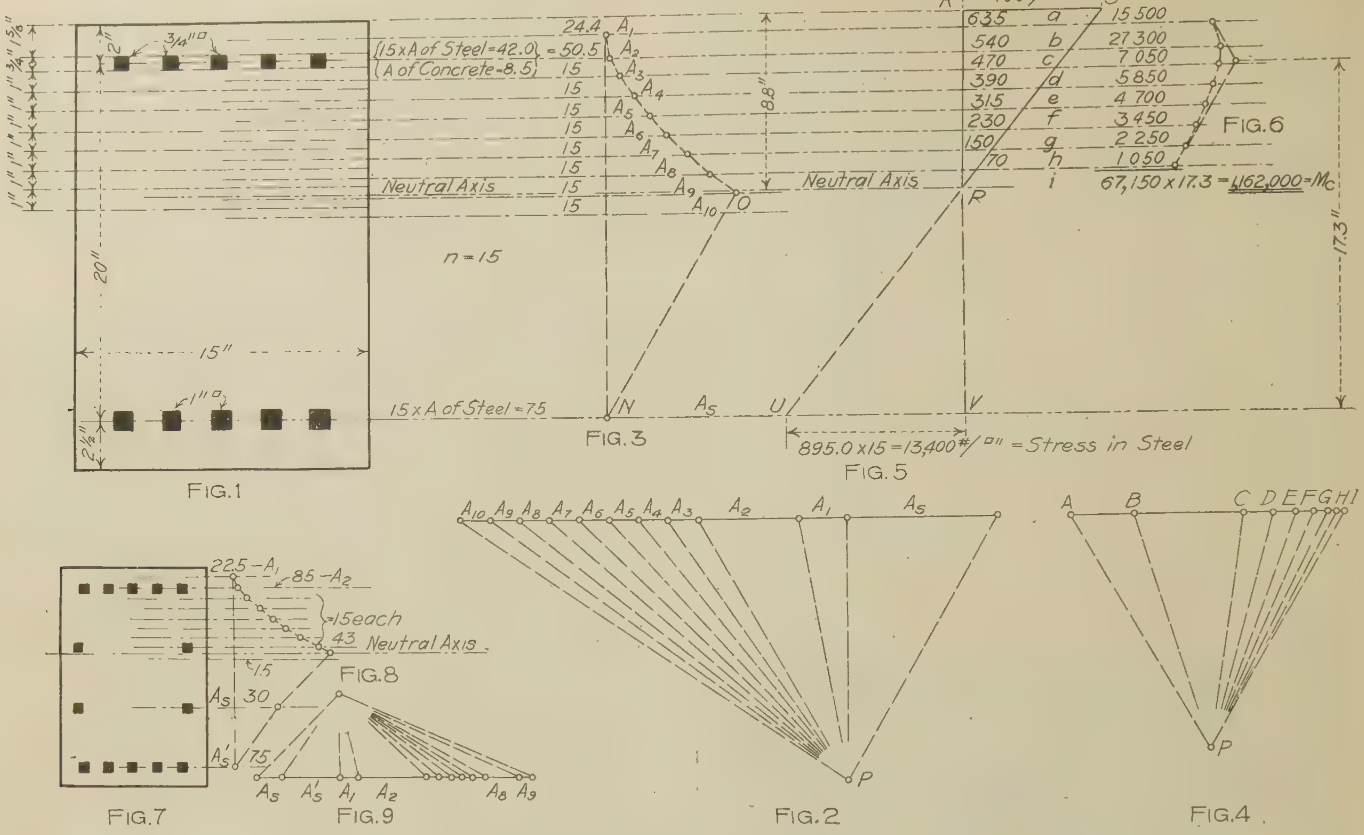
Consider the problem of finding the neutral axis and resisting moment of a given reinforced-concrete beam reinforced on the compression side, as in Fig. 1. Applying the usual method of finding the centroid of an area, the compression side of the beam is divided into thin slices, taken small in order to avoid large errors, and each slice is represented by a force A_1, A_2, etc. In order to obtain a homogeneous section, the area of the steel is always multiplied by $n = 15$, assumed for the ratio between the moduli of elasticity. The force diagram for these "area forces" is then drawn, Fig. 2, beginning with A_8 at one end, A_1 next, etc., as shown.

The funicular polygon for locating the resultant of these forces is then drawn, Fig. 3, and the intersection O of the line NO, with the lines parallel to the rays for the compressive areas, gives the position of this resultant, or the centroid of the section, and hence locates the neutral axis. Note that none of the area below O is used, according to the usual assumption that tension in concrete is neglected.

To Find the Resisting Moment

Now in Fig. 5 the point P is on the neutral axis, just found, RS is drawn to convenient scale to represent the allowable stress in the concrete, 700 lb. per square inch, and the straight line PS is drawn to represent the variation of stress across the section. By scaling the ordinates to this line at centers of the slices considered, and multiplying by their areas, the values of the resisting forces were obtained, after noting that the steel stress in tension is $UV \times 15$, or 13,400 lb., less than the allowable value, showing that the concrete governs. If the steel stress were found to exceed the allowable value, the line UV should be made $16{,}000/n$ to locate the stress line PS, and the steel would govern. The compressive forces are plotted in the force polygon, Fig. 4, in order to locate their resultant by the polygon, Fig. 6, at X.

Knowing the magnitude of the compressive forces, by summation, to be 67,150 lb., the effective depth is



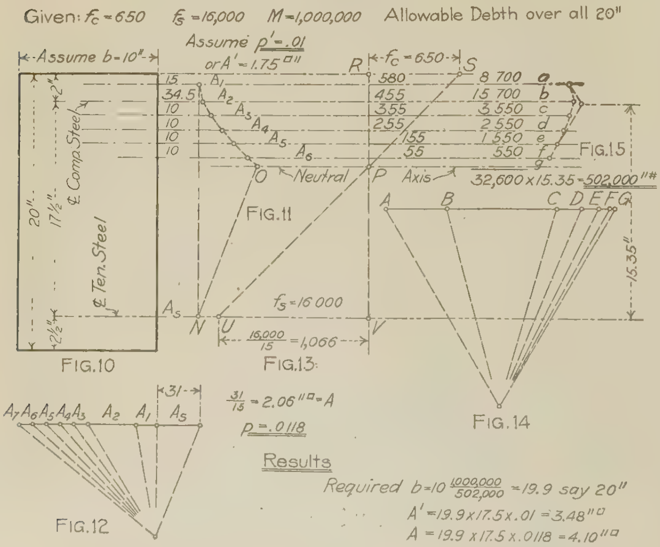
NOTATION AND EXAMPLES ILLUSTRATING THE INVESTIGATION OF GIVEN SECTIONS

scaled off as 17.3 in. and the resisting moment is then 67,150 × 17.3 = 1,162,000 lb.-in. This has been checked closely by the usual formulas.

Application to complex sections, as Fig. 7, can be made as shown by Figs. 8 and 9, locating the neutral axis.

DESIGNING DOUBLE-REINFORCED BEAMS

To design a double-reinforced beam for a given bending moment, first assume the position of the steel and the allowable total depth, and assume a convenient width of, say, 10 in. and a proper value for the compression steel ratio *p'*. The stress line *US* is then drawn in Fig. 13 by making *RS* equal to the allowable compressive stress in the concrete (650) and *UV* equal to the allowable stress in the steel in tension (16,000) divided by *n* (15), or 1066. The intersection *P* then locates the neutral axis.



TO FIND SECTION REQUIRED FOR GIVEN MOMENT

The compression side is divided into a number of slices as shown, and the areas A_1, A_2, etc., computed, knowing the value of A_2 because the compressive steel area is known from the given ratio *p'*. To find the area of tension steel required, the value of A_s is obtained from the polygon, Fig. 11, and the force diagram, Fig. 12, using the closing line *NO*. A_s is then scaled off (31) and divided by *n* (15), giving 2.06 sq. in. for the area desired. The steel ratio *p* is then easily computed. The resisting moment is obtained as before, using the diagrams Figs. 13, 14 and 15, by which a resisting moment of 502,000 lb.-in. is obtained, as shown.

Now, if the width is increased and the steel ratios are kept constant, the resisting moment will increase directly as the increase in width. Therefore if the assumed width be multiplied by the ratio of the required moment to the moment obtained for this width, the required width is found. This computation, given on the diagram, shows that a 20-in. width is necessary. The required areas of steel in compression and tension can then be computed as given, knowing the values of the steel ratios *p* and *p'*.

Moving Troops by Automobiles

The capacity of any road for moving troops by automobiles may be computed about as follows: On roads paved over a width of 16 ft., two machines can travel abreast and, allowing 250 per mile for such a road, would deliver 7000 men per hour where wanted; that is about 3500 men per hour for each 8-ft. width of paved surface, the automobiles traveling 20 miles per hour.

Literature

For the Civil Engineer and Contractor

New Publications

Riveted Boiler Joints. By S. F. Jeter, B.S., M.E., chief engineer, Hartford Steam Boiler Inspection and Insurance Company. Cloth, 8 x 11 in.; 155 pages; illustrated. New York, McGraw-Hill Book Company, Inc.; London, Hill Publishing Company. $3 net.

A treatise on the design and failures of riveted boiler joints, with numerous original diagrams enabling the design of any desired joint to be made without calculations.

The Design of Railway Location. By Clement C. Williams, professor of railway engineering, University of Kansas. Cloth, 6 x 9 in.; 517 pages; illustrated. New York, John Wiley & Sons, Inc.; London, Chapman & Hall, Ltd. $3.50 net.

Report on Valuation and Rates of Citizens Water Supply Company of Newtown, New York City. By Delos F. Wilcox, deputy commissioner, Department of Water Supply, Gas and Electricity, New York City. Cloth, 7 x 10 in.; 378 pages; illustrated. New York, Department of Water Supply, Gas and Electricity.

This report contains a complete account of the city's relations with the company. It was prepared after formal complaint had been made against the company's rates. The report deals with the valuation of the plant, its history, earnings and schedule of rates recommended.

Steam Boilers—Their Theory and Design. By H. de B. Parsons, B.S., M.E.; professor emeritus of practical engineering, Rensselaer Polytechnic Institute. Cloth, 6 x 9 in.; 377 pages; illustrated. New York and London, Longmans Green & Company, $4 net.

Strength of Ships. By A. J. Murray. Cloth, 6 x 9 in.; 400 pages; illustrated. New York and London, Longmans Green & Company. $5 net.

The Co-operative System of Education. By Clyde William Park, associate professor of English, University of Cincinnati. Bulletin 37, U. S. Bureau of Education. Paper, 6 x 9 in.; 48 pages; illustrated. Washington, Government Printing Office.

Instructions to Locating Engineers. By F. Lavis. Cloth, 6 x 9 in.; 44 pages; illustrated. Reproduced in abridged form from the author's "Railroad Location Surveys and Estimates." New York, McGraw-Hill Book Company, Inc. $1 net.

A Logarithmic Stadia Reduction Table. By Francis S. Foote, Jr. Paper, 7 x 10½ in.; 12 pages. Berkeley, Cal. Publication in Engineering No. 11. 10 cents.

Failure of Brass. 1—Microstructure and Initial Stresses in Wrought Brasses of the Type 60 Per Cent Copper and 40 Per Cent Zinc. By P. D. Merica and R. W. Woodward. Paper, 7 x 10 in.; 72 pages; 120 figures. Bulletin 82, U. S. Bureau of Standards. Washington, Government Printing Office.

Books Reviewed

Arithmetic for Engineers

Author, Charles B. Clapham, lecturer in engineering and elementary mathematics at the University of London, Goldsmiths' College. Cloth, 6 x 9 in.; 436 pages; illustrated. New York, E. P. Dutton & Company. $3 net.

This is a comprehensive, practical treatment of the most elementary parts of mathematics, including simple algebra, mensuration, logarithms, graphs and the slide rule. It is written for students of most limited training; in fact, in the endeavor to make all points perfectly clear to this class of readers the explanations and practical examples are given with most comprehensive care, even to the extent of becoming verbose.

The most important feature of the text is the use of at least one practical example to illustrate every principle or procedure described. This results in a fully illustrated volume, filled with stimulating exercises using engineering subjects, presented in a satisfactory form typographically. It should be emphasized, however, that the text is written for elementary students and is in no sense a handbook for reference.

Concrete—Plain and Reinforced

Authors, Frederick W. Taylor, M.E., Sc.D., and Sanford E. Thompson, S.B. Third edition, revised and enlarged. Cloth, 6 x 9 in.; 885 pages; illustrated. New York, John Wiley & Sons, Inc.; London, Chapman & Hall, Ltd. $5 net.

This well-known treatise on concrete and reinforced concrete is now brought up to date by revisions and new material, largely by S. E. Thompson following the death of Dr. Taylor, the senior author. The new edition contains the results of recent developments in theory, design and tests, several chapters being rewritten almost entirely. Other chapters are rearranged and revised to accord with the latest information on the subjects considered, and to include the revised specifications of the joint committees of national societies. For example, the old chapter on reinforced concrete is enlarged and divided into three chapters—one on theory, one on test and one on design. The chapter on building construction is rewritten and now contains many drawings of recently completed concrete structures of various types, including details of formwork, etc.

A new chapter of 12 pages is added to give examples of the design of beam bridges, including slab bridges, deck-girder spans and through-girder spans, with a short statement on continuous-girder bridges. The chapter on chemistry of hydraulic cements, by S. B. Newberry, is revised and new results of experiments are suggested, but not discussed in full. The two chapters on mixing and depositing concrete are rewritten and the results of recent experiments included. The chapter on arches, by F. P. McKibben, remains substantially the same, except that the material on stress distribution has been rewritten and transferred to the chapter on theory of reinforced concrete, where the diagrams to facilitate computation are included. It will be recalled that the book includes chapters by R. Feret and W. B. Fuller in addition to those already mentioned.

It is unnecessary to remind engineers that this book has had exceptional success as a practical and reliable treatise on this subject. In its present form it is a thoroughly modern text presenting the latest data in the field of concrete and reinforced concrete.

Valuation, Depreciation and the Rate Base

Authors, C. E. Grunsky, Eng.D., and C. E. Grunsky, Jr., E.M. Cloth, 6 x 9 in.; 387 pages. New York, John Wiley & Sons, Inc.; London, Chapman & Hall, Ltd. $4 net.

Reviewed by C. W. Stark
Associate Editor Engineering Record

Although this volume is rightly named, in that it discusses all of the subjects mentioned, its appeal to engineers will not be in its treatment of the general principles of valuation, which have been better and more fully set forth elsewhere, but in the extended discussion of depreciation and its effect on the rate base and in the elaborate tables that occupy nearly a third of the book. The authors are not gifted with great clarity of expression, and the reader is sometimes left in semi-obscurity as to what is meant. But dissertations on depreciation will probably never supplant the popular magazines for light reading. The authors are fundamentally sound in their refusal to deduct from the rate base, as depreciation, a part of the investment; and though they call the replacement method the unlimited-life method, and wrap it up in several pages of mathematical equations, this may be due to the fact that the last and best report of the American Society's valuation committee had not appeared when the book went to press—though it has reached the public's hands ahead of the book.

A general introduction and definition occupy the first two chapters. The third chapter, "Fundamental Principles," is very short. The first sentence, however, sounds the keynote of the author's theory—that the earnings of the property should be such that, within the life of the property, there will be returned to the owner his capital, with interest. There are those who prefer to think that the owner's capital shall not be returned to him at all, but shall be allowed to remain permanently in the plant; and even though the authors meet these views mathematically by making the life of the property infinity, they are likely to think this is using a cumbersome process to demonstrate a simple truth. In this chapter, also, the authors introduce methods of depreciation. One of these they unfortunately call the equal-annual-payment method, though the American Society's committee has rechristened this the compound-interest method.

"Essentials of Value" constitutes a fourth chapter, dealing mainly with overhead and intangibles, and then comes a chapter on "Elements Which Reduce Value," in which the authors really begin their microscopic analysis of depreciation, amortization and replacement. It must not be supposed, however, that they stand with the theorists who blithely assume that the exact life length of each item of plant can be set down. On the contrary, a considerable part of their discussion has to do with the large majority of items that die too soon or live too long. Chapter 6 begins this phase of the discussion.

Chapter 7 is on the purpose of the appraisal, Chapter 8 on the fixing of rate and Chapter 9 on possible procedures in fixing rates. The authors never get far from the depreciation question, and present numerous figures and tables for sober study. A brief chapter on land, in which the authors refuse to be frightened out of their senses by the Minnesota rate decision, is followed by a longer one on the value of water rights and watershed lands. These latter subjects have not had too much attention, and the chapter is a good one.

Chapter 12, on the accounting system, is not so good, for it is not up to date. For example, under the heading "Treatment of Depreciation and Replacement, Interstate Commerce Commission," there is no mention of the policy of the Division of Valuation, made public nearly a year ago. Such of the matter as is of value seems to belong somewhere else in the book.

Chapter 13 is on the valuation of mines and oil properties. Few civil engineers, of course, will need it, but with its 33 pages, including production tables, diagrams and a bibliography, it should be very useful to those concerned in its subject.

Chapter 14, tables and their explanation, occupying 105 pages, is the really distinctive part of the book. Although there are eighteen tables preceding this chapter, the reader will find here what he will hardly find anywhere else—probable life lengths of hundreds of items of plant, the authors' authorities given; expectancy and remaining value for life lengths from 5 to 60 years; and a variety of compound-interest, annuity, present-value and amortization tables for a wide range of time periods and interest rates.

In conclusion, then, the reviewer commends the book to the libraries of valuation men, not because it is a model of clearness, nor even because he thinks the depreciation problem is as desperately complex as the authors make it, but because the authors have painstakingly expounded a fair-minded theory about which valuation men should know something, and because they have presented some remarkably complete tables.

Selling Your Services

Cloth, 6 x 9 in.; 176 pages. New York, 627 Madison Avenue, The Sales Service Company. $1 net.

This is not a wonder-working book which will enable a person without qualifications to get a big job. It does tell, however, in a very practical way how one can get a hearing and best present his merits in connection with vacancies which he is fitted to fill.

The book is well worth the reading of anyone seeking a position.

Handbook of Engineering Mathematics

Authors, Walter E. Wynne, B.E., and William Spraragen, B.E. Limp leather, 4¼ x 6¾ in.; 220 pages: illustrated. New York, D. Van Nostrand Company. $2 net.

This book, intended primarily for students in engineering, is a handy means of reference to theoretical and applied mathematics, and includes, in addition, the principal constants and formulas for strength of materials, hydraulics and electricity. The solution of differential equations is given in a practical form, and all the important fundamental formulas of calculus are tabulated in a manner very convenient for ready reference. This part of the book will probably prove to be most useful to those engineers in actual practice who desire to apply exact methods of calculus to such problems as can be solved in that way—and it must be admitted that in too many cases engineers have been deterred from mathematical solutions of problems because of lack of familiarity with these tools.

The highly condensed form in which the formulas are presented makes it possible to include in the 214 pages not only those of algebra, geometry, trigonometry, analytic geometry, and calculus, but also hyperbolic functions, theoretical mechanics, mechanics of materials, hydraulics, and electricity, together with the usual tables of weights and measures and physical and chemical constants.

This book will prove to be extremely valuable not only to engineering students but to all practising engineers who desire a handy reference tool to give them immediate facility in the application of mathematical formulas and methods to the solution of practical problems.

Letters to the Editor

Comment on matters of interest to engineers and contractors will be welcomed

Professional Unity vs. Internal Strife

SIR: As noted in the Engineering Record of March 3, page 365, H. J. Burt, president of the Western Society of Engineers, in addressing the Iowa Engineering Society, called attention to the tendency among employee engineers to invoke the principles of unionism.

It is not with the intent of giving counsel to employers or employees that I submit these remarks, but I offer such assistance as I am able to give to prevent the domination of engineering work by union practices. Union is based on co-operation for the good of the members. This is the principle, whatever the practice. Observation shows that co-operative enterprises fail except in cases where necessity demands co-operation. Under conditions favorable to its growth, co-operation has surpassed the bounds of reason. Such has been the history of unionism in this country. Opposition to organized labor has added the spur to action and unionism has become dictator in numerous lines of activities. If causes similar to those which contributed to the inception of trades unions exist in engineering work, we can, from past experiences, predict with reasonable certainty the outcome.

The start of unionism in Chicago is only one phase of co-operative developments extending over a period of years. Activities have not been confined to Chicago, but are fairly widespread. There are to-day scattered throughout the country a number of independent organizations of engineers working for the solution of the problem of how to deal with fluctuating economic conditions, in competition with organizations of similar nature in nearly every line of work. Stated in another way, this is the problem of how to obtain from the ultimate consumer sufficient return for services to enable the employee engineer to meet the demands made upon him. It is quite useless to argue that the cause is not sufficient to produce an effect. The measure of the cause is the demand made upon the engineer as a man and his ability to pay his bills. The very persistence in the effort to find a solution for this problem is an indication of its importance.

In justice to these organizations it should be stated that in many, if not all, cases they started with a fair and open-minded purpose. The fact was clearly established that employing engineers were not responsible for the cause and that they could not, unaided, apply a remedy. The idea has been held that an organization of both employers and employees could place engineering on a basis to compete fairly with other lines of work for a favorable place in the organization of social and civic activities.

Some employers have not taken kindly to the proposition. Others have expressed themselves as helpless and stated frankly that it is up to the employees themselves. Attitudes vary all the way from friendly to antagonistic. The same range of feeling exists in the ranks of employees, but I believe the antagonism to organization is becoming less as the need becomes greater.

There is a growing feeling on the part of the employees that the employing engineers stand between them and the remedy—not as an enemy but as a stone wall. Herein lies the undesirable feature of the movement as concerning employees and employer alike. There is danger that conditions may become acute and sentiment will crystallize so as to bring about strife between employer and employee. This would be disastrous to the engineering profession, and particularly so to those organizations which do a purely engineering business and have nothing to sell except service.

The best that can be hoped for is that the engineering profession will prove itself superior to precedent and not try to settle a question which concerns both employer and employee alike by encouraging internal strife.

C. E. SCHUTT,
Chicago. Electrical Engineer.

Motor-Truck Regulation

SIR: The discussion started in the Engineering Record of Oct. 28, 1916, page 519, is a most timely one and should receive the careful consideration of every person interested in highways, but especially of highway engineers. While in Yellowstone Park we have to date only a few miles of modern hard-surfaced roads, such as macadam finished with asphaltic oil, yet the problem of regulating the width of tires and weight of loads has been under consideration for a number of years by the engineer officers in charge. Indeed, through the efforts, several years ago, of Gen. H. M. Chittenden, Corps of Engineers (retired), all persons doing freighting in Yellowstone Park were obliged to use wagons with 4-in. tires. Many of the present roads had been newly constructed at that time and had been more or less thoroughly surfaced with natural gravel, helped out in a few instances by crushed rock. The wider tires did not apply, however, to passenger-carrying coaches; and as some of these coaches were drawn by six horses and were built to hold nearly thirty people in addition to baggage, the weight sometimes reached 1000 lb. per inch width of tire. This coach traffic was very severe on the roads.

It is probable that more attention was given to the width of tires for freight wagons than for coaches, because most of the freighting was done prior to and during the first weeks of the tourist season in the spring and at the close of and after the tourist season. For this reason the coaches operated generally during the most favorable, driest months, while the freight wagons operated when the frost was entering the ground or just coming out. This early-and-late freighting over roads subject to alternate thawing and freezing, coupled with the sheep-like traits of all freighters to travel exactly in the track of all preceding freighters, resulted in cutting the roads very badly. Indeed no freighter, to my knowledge, was ever known to get out of a rut until it got so deep that he was stuck or his load overturned.

This condition is mentioned somewhat at length for the reason that the wider tires probably did much less to save the roads than the originators of the idea thought, or than most people now think. The freighters did exactly what the motor-truck builders and motor-truck operators are now doing: they increased the weight of their loads to the limit which the road would stand, putting on sufficient animals to haul the load. That motor-truck builders and operators will continue to do the same is human nature and bound to occur unless restricted by properly drawn and enforced laws. While the heavily loaded freight wagon with steel tires was bad enough, a steel-tired trailer or truck is far worse on account of the speed and weight of the loads. Accordingly, from my observations I am inclined to agree with those who would require rubber or other type of cushions on all automobile and trailer tires.

In this connection I noted about two years ago on the harbor boulevard between Los Angeles and its harbor that the track of the steel trailer wheels could be followed for miles, whereas trucks with rubber tires made no impression whatever. I do not think tenable the contention of motor-truck builders that if motor-driven vehicles and all trailers operated by them are required to have cushion tires the same should be stipulated for animal-drawn vehicles. I base this opinion solely on the increased speed of the trucks. The hammer effect of heavy loads on solid tires at high speed is too well known to need comment, and nothing less smooth and hard than the rails of a railroad will stand much of such abuse. There are, and always will be, slight inequalities in every highway, and wherever a heavy load with steel tires strikes these inequalities disintegration will begin and continue at an ever-increasing rate unless immediately repaired.

I note reference in the discussion to a limiting width of 90 in. for trucks. This ought to be sufficient, and certainly if it does not prove so will enforce consideration of wider roadways. Length and width of trucks in general are of somewhat less importance in country districts than in cities where traffic is so heavy during much of the time as to require several lines of vehicles; and it may be readily found that a size and width of truck that can be operated successfully in small towns and country districts will have to be debarred from operating in large cities or restricted closely to certain streets.

There seems to be for a great many classes of traffic a reversion of sentiment from heavy trucks and heavy loads to lighter trucks and higher speed. On oil or tar-finished roads or concrete roads, where speed does not destroy the surface, this change of sentiment is a good thing. On other classes of roads the reverse may be true. For instance, observation of automobile and truck travel through Yellowstone Park during the season of 1916 indicates that touring cars and high-speed, 2-ton trucks are easier on comparatively wet or muddy roads than the slow-speed, heavily loaded trucks. When the roads get dry, however, the reverse is true, the high speed trucks abrading the road material and forming dust very rapidly, while the slower speed and heavy load of the other type of truck tend to smooth down and run over the dust. In wet weather the slow-speed truck in natural soil roads must have chains or some other means to prevent slipping. These chains tear the road very badly. In 1916 nearly 4000 automobiles and light, high-speed trucks made the trip through Yellowstone Park, but there was only a comparatively small number of heavy trucks. This distribution, combined with the dry season, caused the wear on the roads from the high-speed machines to be much greater than that from the trucks. With a large increase in heavy trucks and a wet season, the reverse will probably occur.

We are now introducing into the park trucks of from 5 to 5½ tons weight, the trucks being built to haul loads about equal to their weight, making the maximum weight of truck and load 20,000 to 22,000 lb. These trucks are approximately 7 ft. in width, and on our 18-ft. roadways I find it advisable to pass them in an automobile with care; otherwise, I am in serious danger of striking them or of getting off the road.

It would seem that truck builders might well learn from the experience of railroads. I believe it is generally conceded by railroad engineers that a gage of 6 or 7 ft. would result in a great deal of economy over the present standard gage of 4 ft. 8½ in. But all thought of making such a change has been definitely given up, at least for the present, on account of the hundreds of millions of dollars invested in roadbed, rolling stock, tunnels and all other parts that go to make up a great railroad system. In the same way this country has now spent hundreds of millions of dollars on more or less permanent highways that are able to stand a certain traffic and certain loads. The public cannot afford, and will not consider, rebuilding these roads to care for the immensely heavy trucks and trailers that certain manufacturers and users would like to build and use, and it would be well for them to recall the whirlwind that the policy pursued by the railroads a generation or two ago of "the public be damned" has brought down upon them within the past ten years. It certainly would be to the vast interest of automobile truck builders to determine the loads that roads will bear safely and build their trucks accordingly. If they do not, the users of their trucks, and naturally the builders themselves, will suffer from the restrictive laws that will be passed, not only by every state but by nearly every city, county and village in the land.

Amos A. Fries,
Portland, Ore. Major, Corps of Engineers.

A New Era in Teaching English to Engineers

Sir: I have read with much interest the articles in the Engineering Record of Feb. 24, page 291, on the teaching of English to engineers, and also the editorial on the same subject.

For the last ten years I have devoted considerable time and thought to this subject as perhaps one of the most important in engineering education. Several years ago I addressed a series of letters to some of the older Purdue graduates and also to firms employing graduates, asking for criticisms and suggestions concerning the technical course we offer. The comment of both graduates and employers was almost uniformly favorable, and but little criticism was offered on the technical work.

There was, however, a surprising unanimity in criticism of the English attainments of engineering graduates. This was not confined to the letters received from employers, but was also noticeable in the replies from graduates. The opinion was freely expressed that college students were not able to speak and write their mother tongue correctly.

As I suppose is the case at other institutions, the difficulty here arises from a lack of collaboration between the English department and the engineering schools. The teacher of English usually regards his subject as sufficient unto itself and regards its application to technical writing as a secondary matter. The student realizes this and naturally fails to see any connection between English and engineering.

We are endeavoring to remedy this state of things and have made considerable progress. The introduction of new courses in debating and journalism has given a practical trend to the English instruction. Elective courses during the junior and senior years are now offered for engineering students. Furthermore, any student who shows a lack of training in preparing reports or other written matter can be sent back to the English department for further instruction. Seminar courses in the speaking and writing of technical English are given in the senior year. In the remodeling of the curriculum which is now being worked out here, more emphasis is being laid on fundamental subjects, especially language, and the amount of time devoted to technical work is correspondingly reduced.

In comparing the articles by Professor Park and Professor Aydelotte, I see no necessary conflict between them. Professor Aydelotte urges the laying of a broad foundation in English and the cultivation of a proper attitude toward literary subjects and a living connection is established between English in the learning and English in the application. Professor Park emphasizes the writing of technical English and the more practical applications of English composition. It seems to me that these two suggestions supplement each other, and I would suggest a sympathetic attitude on the part of English teachers toward the subject of technical writing which shall prepare the way for more specialized courses like those outlined by Professor Park for the junior and senior years. I believe that every one of the four years in college should see a certain amount of English training and that this may be so connected as to keep the subject continually before the mind of the student.

C. H. Benjamin,
Dean, Schools of Engineering, Purdue University.
Lafayette, Ind.

Proposed Specifications for Structural-Steel Buildings

Sir: Kindly permit me to comment on the proposed specifications for structural-steel buildings, by R. Fleming, appearing in your issue of Dec. 9, 1916, page 708. Mr. Fleming gives 500 lb. per square inch for tension on rivets, then he virtually forbids the use of rivets in tension and gives bolts the preference. Tension on rivets cannot be avoided. Why not recognize this and make provision for proper details? (See my book, "Steel Designing," page 454.) Rivets seal up a joint and cannot work loose. Nuts are apt to work off, especially if there is jarring, or they may never be made tight. I have found it extremely difficult to get a contractor to use good bolts or to tighten nuts. Half a dozen bolts generally give more trouble than a hundred rivets.

Riveted joints can be controlled by the draftsman, for the contractor knows he has to drive rivets. But a little note on a tracing that a certain connection must be made with tightly-fitting bolts may produce nothing more than a few soft, loosely fitting erection bolts.

Mr. Fleming states that plate girders may be proportioned by their moment of inertia. Why? The other method is simple and definite and gives equivalent results, in general. He should state whether gross section or net section is meant. The former would not be correct; and the latter, if only tension holes be deducted, would introduce extreme complication.

He would make girder webs 1/160 of the clear depth in thickness. This is extremely severe for building work and is uneconomical. I have known of much railroad work where the ratio was less than 1/200. The latter is, however, a good lower limit.

He would design girder stiffeners as columns. Why? There is no column action in intermediate stiffeners. They simply hold the web flat. The web takes the shear. Furthermore, he calls for 56,000 to 64,000-lb. steel. Why not specify 55,000 to 65,000, the standard now very generally used?

Pittsburgh. Edward Godfrey.

[The foregoing letter was submitted to Mr. Fleming and his reply follows.]

Sir: Referring in sequence to the points raised in Mr. Godfrey's letter: Bolts in tension are given preference to rivets in tension where "the loads carried are subject to shock." In the common case of trolley beams which may be fastened to the bottom chords of roof trusses by bolts or rivets passing through the top flanges, bolts are to be preferred. The shock or impact from the moving trolley on the lower flanges is liable to snap the heads of rivets. The check nuts specified will keep bolts from working loose. In high office buildings with wind bracing without diagonals, rivets in tension are generally used for the connection of gussets to columns.

It is often desirable that girders be calculated by their moments of inertia, especially when they are to be compared with rolled beams of the larger sizes. Tests show that girders and beams fail in the compression flange; that is, the tension flange is the stronger of the two. For this reason I see no objection to the gross section being used, though not theoretically correct. However, as the excess over the allowable tensile stress mentioned elsewhere in the specifications is liable to be worked overtime, it might be well either to specify that in calculating the moment of inertia deduction of area shall be made for holes in the tension flange or to omit the words "Plate girders may also be proportioned by their moments of inertia."

Incidentally, it may be noted that the section in the building code of Pittsburgh relating to girders begins: "Rolled I-beams and channels and built-up members used as beams and girders shall be proportioned by their moments of inertia. Plate-girder webs shall have a thickness not less than 1/160 of the unsupported distance between flange angles."

The specification calling for girder webs to have a thickness not less than 1/160 of the unsupported distance between flange angles allows a ¼-in. plate to be used for 40-in. clear distance, a 5/16-in. plate for 50 in. and a ⅜-in. plate for 60 in. These thicknesses do not seem severe or uneconomical. Railroad engineers would certainly object to girders having a distance of 50 in. between flange angles, practically 5-ft. girders, with webs only ¼ in. thick.

The paragraph regarding stiffeners is faulty in not clearly expressing the meaning intended. Only the stiffeners over bearings and under concentrated loads need be designed as columns.

The ultimate tensile strength of 56,000 to 64,000 is that given in the specifications of the American Railway Engineering Association and has been followed in the majority of buildings of which the writer has personal knowledge. The 55,000 to 65,000 of other specifications is coming into more general use and there is no objection to their being substituted for those given.

New York. R. FLEMING.

Inclined Tunnels Used Thirty Years Ago

SIR: The description in your issue of Feb. 24 of the skillful work done by the Foundation Company in connection with the strengthening of the foundations under the power house on the American side of Sault Ste. Marie brings to my recollection a report which I made to the Consolidated Lake Superior Company in May, 1903, on the condition of the pile foundations and what ought to be done to make them safe against the lateral pressure from the water dammed up behind the power house. In my report I recommended the very method of inclined pneumatic cylinder struts filled with concrete that has at last been adopted and carried out. The long delay of 13 years is probably due to the financial inability of the company to have the work done sooner.

Inclined caisson struts for taking up lateral forces in foundations were used long before that, in 1886, for strengthening the west abutment of the Chestnut Street bridge in Philadelphia over the Schuylkill River, built in the early 60's. This structure is an arch bridge of two spans with cast-iron arches. The west abutment is a mass of masonry resting on a pile foundation which commenced to give way under the thrust of the arches some years after completion of bridge. It was proposed in 1884 to strengthen that abutment and stop its further movement by sinking a big caisson foundation back of it down to rock, estimated to cost $180,000. I made a plan for two inclined caisson struts, carrying the thrust of the arches directly down to rock. The plan was appropriated by the city without compensation to me and carried out at a cost of $50,000. It was the first time, as far as I know, that such a construction was proposed and used, so that I may claim to be the originator of it.

GUSTAV LINDENTHAL,
New York. Consulting Engineer.

[It was not the intention in the preparation of the article in question to take up the origin of the method employed, or to credit its suggestion to anyone mentioned in the article as connected with the work. In view of Mr. Lindenthal's letter, however, it was thought proper to submit his statement for public confirmation to Mr. Davis, general manager of the Michigan Northern Power Company, whose reply follows.—EDITOR.]

SIR: Referring to Mr. Lindenthal's letter regarding the article on page 292 of the Engineering Record of Feb. 24, 1917, describing work done on the reinforcement of the foundations of the power house of the Michigan Northern Power Company at Sault Ste. Marie, Mich., it is proper and fair to state that Mr. Lindenthal was the first to suggest the idea of buttressing the power house of this company with pneumatic cylinder struts, recommendation along which lines was made, as Mr. Lindenthal states, in his report to the then Consolidated Lake Superior Company in May, 1903.

The article in question was written from the contractor's viewpoint, primarily to describe the construction methods on the work, but not at all to discuss the various designs which had been considered in connection with the work. If such an article should be prepared, due credit will be given to those who have suggested various ingenious solutions of the problem to be met.

L. H. DAVIS,
General Manager, Michigan Northern Power Company.
Sault Ste. Marie, Mich.

Swaying the Level Rod

SIR: In S. Groman's article, "Swaying of Level Rod Causes Errors in Readings," printed in the Engineering Record of March 10, page 381, the errors cited exist for the swaying of the rod on a flat surface or on a point not in the plane of the face of the rod; but as only these cases are considered, his conclusion that swaying should be prohibited ought not condemn the practice as a whole.

When a rod bubble is not available the following method will eliminate the errors caused by swaying: For turning points a stake is driven firmly into the ground and a finishing nail driven to within ⅛ in. of the top of the stake. A cross-mark in the plane of the face of the rod and midway of the sides of the rod is made on the bottom of the rod, and the center of the cross set over the nail. In swaying the rod the point (nail head) remains in the same plane as the face of the rod.

CHARLES F. NIMMO.
U. S. Engineer Office, Dam 33, Ohio River.
Maysville, Ky.

Gain in City-Planning Movement

During the last year nearly 45 per cent of the cities of more than 100,000 population in the United States and 15 per cent of the cities of from 25,000 to 100,000 population have made important and constructive advances in city planning, according to George B. Ford, chairman of the committees of the American Institute of Architects, in an address before the annual convention of the National Municipal League, recently held at Springfield, Mass. The activity developed throughout America among semi-public or official bodies and in the legislatures of many states is said to be unprecedented. At a meeting of the National Conference on City Planning held last June a committee was appointed to study the possibilities of securing a national bureau for city planning and municipal investigation. In regard to city planning in general, Mr. Ford states that enormous strides are not only being made in the United States and Canada, but in France, England and even in India, and that never has the movement enjoyed a more hopeful and constructive year than the past.

HINTS FOR THE CONTRACTOR

Details Which Save Time and Labor on Construction Work

Field Telephone With Handy Clamp Connections Invaluable on Road Work

By C. A. HOLTON
Division Engineer, Vermilion County Bond Roads,
Danville, Ill.

GOOD USE was made of a field telephone on division 7 of the Vermilion County bond-issue roads. There was a telephone led along the road under construction, as is the case with almost all roads to be improved. The telephone company went along the line and placed drop wires about 1000 ft. apart. These drops were all connected with the same line, which was a party wire. The telephone was placed in a storm-proof box with a door held shut by a padlock. A large gong was attached to the telephone and placed in a separate compartment at the bottom of the box. This compartment was open on the bottom so that the bell could be heard at a distance. The connections to the drop wires were made by means of clamps which did away with the usual scraping of wires and wrapping with tape. The box was hung from the pole on a small railroad spike.

Don't Stop

SENDING IN your "Hints" with the idea that this section will be discontinued after the consolidation of the Engineering Record with the Engineering News on April 5.

NOT MUCH! With your help, the Engineering News-Record will keep right on publishing

HINTS FOR THE CONTRACTOR

The telephone was carried forward as the mixer progressed and was always located so that the large gong could be heard from the mixer. It was almost invaluable in keeping in touch with the office, which was from 1 to 3 miles away. The use of the telephone prevented delays from shortage of material, getting repairs to the mixer and other causes. It paid for itself many times over.

The telephone was employed by the Granite City Lime & Cement Company, contractors for this section.

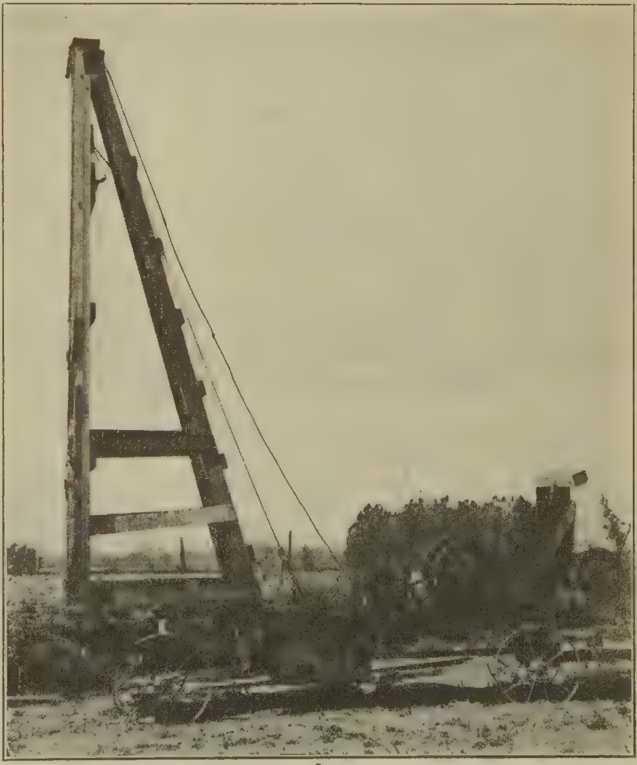
Driver Made of Farm Truck, Gas Engine and Old Mixer Drum Does Rush Job

THE ROAD DEPARTMENT of Los Angeles County, California, recently, under the necessity of carrying out rush work in protecting the banks of a stream subject to sudden floods, assembled from discarded material a driver which cut the cost of placing pipe piles by 90 per cent. Before the emergency, the banks were being protected by driving parallel rows of 2-in. pipe which served as posts to support the wire and brush bulkhead that prevented the current from cutting away the bank behind. These pipes were being driven by hand, using a heavy maul. The work advanced well enough in soft ground, but when rocky ground was encountered it was rendered more difficult, with a corresponding increase in cost and time.

When sudden high water was threatened it became necessary to speed up the work in some way. Accordingly a 3-hp. gas engine which was on hand in the division shops was mounted on a farm trailer and connected by chain drive with a small drum taken from an old concrete mixer. Leads 16 ft. in height were built on the wagon bed with hinged supports to permit them to be lowered in transit. A 2-ft. length of 4-in. steel shafting which weighed about 125 lb. was found in the shops and was drafted for use as a hammer. The leads were fitted for it by facing them with angle iron, the apex of the V's being set in the timber and the insides of angles forming a groove for the hammer.

At first the length of pipe to be driven was held in place by hand. Later it was found feasible to hold the pipe by strap iron guides slipped into brackets on the leads. These guides, in pairs on opposite sides of the leads, were curved to fit the pipe. They were removed each time just before the head of the pipe being driven reached the level of the guide.

Another improvement effected after the first trial was changing the size of the cable from ½ in. to ⅜ in. The cable first tried was too stiff and the bending caused by the slack formed after each blow would break the



BUILT IN 32 HOURS, IT DROVE PIPE PILES FOR 2 CENTS A FOOT cable. A light strap-iron guide was made up by the blacksmith and fastened over the drum to prevent the cable from jumping off when the slack ran back in the line.

The cost of using the hand maul for driving the pipe was about 10 cents per foot of penetration. After the power driver was in working order the cost was cut to 1 cent per linear foot driven, and pipe was put down in rocky ground in which driving by hand would not have been feasible. Also the driver could handle pipe up to about 15 ft. long, while in driving by hand a length of 10 ft. was about the maximum.

About 325 pipes were driven, the average day's run being 60 pipes. On the best day's run 70 pieces of 2-in. iron pipe 15 ft. long were driven in the ground to an average depth of 11 ft. in 8 hours. On this day the cost of gasoline and oil used was 50 cents and the wages of three men amounted to $7.75, a total for fuel and labor of $8.25, or about 1 cent per linear foot of pipe driven.

All parts which were used in the makeup of this rig were available in the shop at division headquarters or were made up by the blacksmith from materials at hand. The driver was assembled and made ready for service by four workmen in about 32 hours.

The driver was first used on the Baldwin Park Division of the road work being carried out by the Los Angeles County Road Department, of which F. H. Joyner is commissioner; A. B. Smith, division engineer, and H. J. Parker, foreman.

Tap Thin Wall Form with Six-Pound Maul to Tamp Stiff Concrete

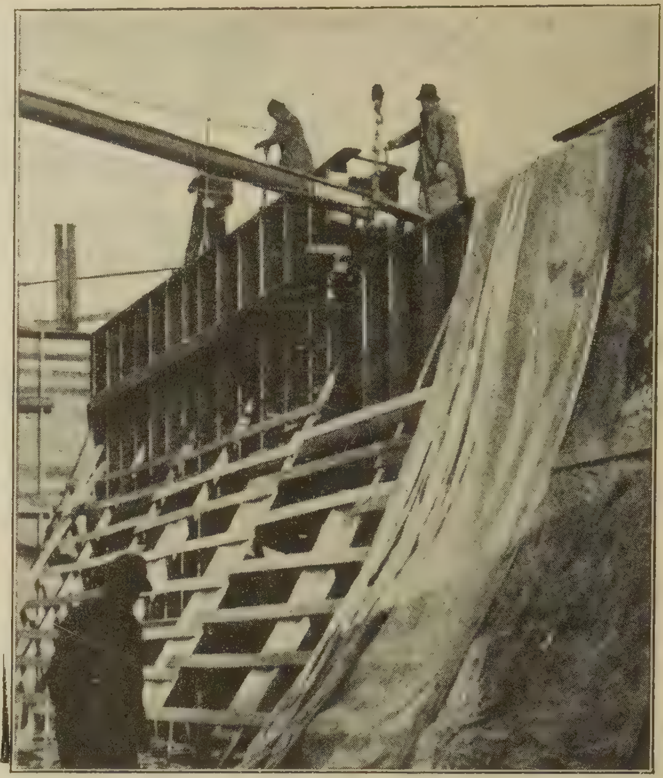
By H. S. CARPENTER
Cobleskill, N. Y.

IN CONCRETING a wall 11 in. thick a satisfactory job is being secured without using wet concrete and without tamping or spading by jarring the forms and reinforcing with a wooden mallet. In view of the letter from C. C. Howell, published in the Engineering Record of March 10, page 395, it appears that everyone is not aware that concrete of a "quaky" consistency can be placed in thin, heavily reinforced sections in this way. The hammer, a wooden mallet, should weigh about 6 lb. By striking quick, light blows with it the concrete will be caused to settle tightly against the forms and around the reinforcing.

Carry End of Chute Along High Form on Block Hung from Cable

By JAMES A. CAIN
Sistersville, W. Va.

HANGING the end of the chute from a single block running on a cable rigged above the wall forms for the new filtration plant at Sistersville, W. Va., has made it easy to move the chute frequently to avoid separation of the aggregate caused from allowing the concrete to pile up at one place in the forms for too long at a time. The outside walls of this plant are high and heavily reinforced, leaving very little room for men to spade the concrete properly. A wet mixture was therefore necessary, but it was discovered that unless the chute was moved along the form every 20 minutes or so the gravel would pile up, allowing the sand, cement and water to run off. The cable shown in the photograph was therefore rigged to secure better distribution. It was 7 ft. above and parallel to the top opening of the form. The end of the chute, suspended by an adjustable chain from a block riding on the cable, could then be moved along the form at will.



BETTER DISTRIBUTION OF CONCRETE SECURED WITH SIMPLE RIG

The construction of the plant, which is under the direction of the writer, is being carried out by Dayton & Francis, general contractors, of New Martinsville, W. Va., under the supervision of Douglass & McKnight, engineers, of Pittsburgh, Pa.

Air Hammers Driven by Portable Compressor Calk Pipe Joints Rapidly

By C. G. CUMMINGS
New York City

IN CONSTRUCTING a 12-in. pipe line a short while ago the Burro Mountain Copper Company, Tyrone, N. M., used two small air hammers supplied by a portable gasoline-driven compressor to calk the pipe at the rate of 30 to 40 joints per day. The Sullivan compressor was belt-driven by a 8-hp. gasoline engine, the plant being mounted on skids. Two small hand drills fitted with special calking tools made on the job were used to calk 15 to 20 joints apiece daily with oakum and soft lead. The compressor remained at one place until the ¾-in. pipe line to the drills became 500 ft. long, when the machine would be moved ahead. The large pipe was laid and calked at a rate of 400 ft. per day. The foreman stated that the progress of the work was limited by the rate at which the trench could be dug and that the two hammers could have calked 60 per cent more pipe per day if the trench in which to lay it had been ready.

NEWS OF THE WEEK

Passing Events in the Civil Engineering and Contracting Fields

Utah Ousts Power Companies from Public Lands

U. S. Supreme Court Sustains Injunction and Upholds Federal and Limited State Sovereignty

The Supreme Court of the United States, in a decision handed down March 19, has decided against the power companies in the government's suit to oust the Utah Power & Light Company and the Beaver River Power Company from public lands in the Wasatch and Fillmore forest reservations in Utah. The decision sustains the injunction in the Utah power case and upholds federal and limited State sovereignty.

The power companies, both of which are Colorado corporations, had permission from that State to develop water power in the forest reservations for public purposes. The question of State rights was therefore intimately involved, as the power companies contended in the courts that the State, and not the federal government, had the right to permit the use of public lands, even government lands, to develop public resources.

The decision settles many important questions as to possible electric-power development not only in Utah but in Nevada, California, Colorado, Idaho, and other States where there are "public lands." Some of these States intervened, claiming they had control.

The Utah courts sustained the claim of federal control, and ordered the power companies off the public domain. The attorneys general of the States where there are "public lands" claimed they had authority to develop resources for public purposes. Ownership by the federal government was conceded by these States, and ownership of the water was not directly questioned.

Engineers to Discuss Their Profession at Chicago

The welfare and future of the engineering profession will be up for discussion March 29 and 30, when the committee on engineering co-operation holds its third annual conference at 1735 Monadnock Block, Chicago. Explicit plans for the improvement of professional conditions will be proposed by its leading members, and possibly adopted by the half-hundred societies to be represented. The committee not only welcomes comments from the society representatives, but it also invites discussion from all other engineers.

The report of the subcommittee, prepared after the meeting of November, 1916, for presentation to next week's conference, is abstracted elsewhere in this issue.

Two Die When Caught by Air Suction in Dam

A strange accident which occurred at the Elephant Butte Dam, New Mexico, resulting in the death of F. O. Babcock and H. E. Reid, has been reported by A. P. Davis, director and chief engineer of the U. S. Reclamation Service.

Babcock went on duty in the power house at 4 p. m. and was to be relieved by Lewis an hour or two later. Lewis went to the power house and, not seeing Babcock, went through the dam looking for him. In the air inlet chamber of the west upper valve he found both Babcock and Reid standing with their faces to the wall, their bodies held in place by the suction of the air inlet tube. Babcock's right arm was extended into the tube as if he had been pointing out something to Reid. The latter may have approached to see better, when his overcoat and body, as well as that of Babcock's, practically closed the opening. The suction due to vacuum not only held the men fast, but exerted a pressure of some 6000 lb. on the portion of their bodies exposed to the action. To release them Lewis had first to close the valve.

Connecticut Engineers to Take War Census

At the meeting of the Connecticut Society of Civil Engineers, held recently at New Haven and attended by more than 130 registered members, papers were presented by Caleb Mills Saville, president of the New England Waterworks Association, and by J. W. Rollins, of the Holbrook, Cabot & Rollins Corporation, on deep foundations. Other speakers presented several interesting engineering topics. Telegrams were sent to President Wilson, approving his patriotic steps in connection with Germany, and to Governor Holcomb of Connecticut.

Addresses were given both by Major La Forge and Major Verrill, engineer officers of the Third District, U. S. A., on the details and formation of an Engineer Officers' Reserve Corps. The society voted to take a census of its members to have information in the hands of the secretary which would be of service in case engineering assistance should suddenly become necessary in connection with the movement of troops. The officers elected are as follows: President, Henry R. Buck, Hartford; vice-presidents, William R. Dunham, Jr., New Haven, and Charles J. Bennett, Hartford; secretary and treasurer, J. Frederick Jackson, Hartford, and assistant secretary, Robert J. Ross, Hartford.

Waterworks Men Discuss Boards of Health

Well-Pumping Costs, State Legislation and Frozen Meters Command Attention of Waterworks Men

Fewer papers and more discussions than usual were indulged in at the annual meeting of the Illinois section of the American Waterworks Association, held March 13 and 14. Deep-well pumping data of a nature hard to find, reasons for meters freezing, rigid board of health control of sanitation versus advisory control and filtration of all water supplies drawn from Lake Michigan were the main topics.

Many Middle West superintendents had much more trouble than usual with frozen meters during this past winter on account of the protracted cold weather and the small fall of snow. W. E. Lautz of Pekin reported that of the 700 meters set outside, 20 per cent were frozen, and that this was the first year that trouble had been experienced. Jay A. Craven, of the Terre Haute Water Company, reported 175 meters frozen, and an investigation did not disclose any reason except the unusually cold winter. No evidence was found to indicate that any one type of box or setting had any particular advantages and the only reason why more meters did not freeze seemed to be the large amount of water passed by them.

The Champaign & Urbana Water Company has 150 meters of its total of 5000 set at the curb. Never before have these frozen, but 10 per cent of them gave trouble this winter, due, according to F. C. Amsbary, manager, to the fact that they were set within 10 in. of the ground surface. Meters having an 18-in. cover did not freeze, nor did the risers freeze if they were kept away from the sides of the box. A member suggested the use of a felt-lined wood cover set down over the top of the meter inside of the box as an effective barrier to the frost.

Deep-Well Data

Melvin L. Enger gave detailed monthly cost figures based on sixteen months' operation of five 140-ft. wells supplying the University at Urbana. The total maintenance cost was equivalent to $151 per year for one pump operating 15.6 hours per day or 0.82 cent per 1000 gal. pumped. Ira W. Fisk presented a study of 22 electrically driven well pumps of the Champaign & Urbana Water Company from the standpoint of proper power load on the motors. The experiments are not finished, but they indicate that smaller motors and larger flywheels would give a more uniform and efficient load factor.

A Board of Health with Teeth

Paul Hansen, chairman of the section, in the absence of Dr. C. St. Clair Drake, secretary, State Board of Health, read the latter's paper on the "Proposed Reorganization of the Illinois State Board of Health." Mr. Hansen expressed the opinion that while it is the function of the board to exercise police powers over sanitary matters as they affect health, it should give the local authorities the widest latitude in working out their own problems. Nevertheless, there are limits beyond which the municipalities should not be allowed to go. With this view John W. Alvord took issue, holding that the state authority's field should be largely, if not wholly, advisory, as has been the work of the state water survey. He cited the cases of Massachusetts and Ohio as being states wherein arbitrary control had led more or less to an overthrow of the department. It is his idea that Americans are not a docile people, and must be led by education, not driven by arbitrary rulings. If a state department proceeds to use such power it will fast put itself out of business.

S. A. Greeley felt a central control department was essential in handling intercity problems. He cited the present typhoid epidemic in the North Shore district as an illustration. Cities and towns to the north of Winnetka, for which Mr. Greeley is alderman, have numerous typhoid cases and discharge untreated sewage into the lake. They also drink a water that is treated, if at all, by only an emergency sterilization plant. His own town under these circumstances needs filters. State water officials have used all of their advisory powers, but something stronger is needed to bring about action—some outside authority on which the local adherents of better things can hang additional arguments for expenditures for filtration works.

Chicago's Water Supply Menaced

Walter A. Shaw, of the Illinois State Public Utilities Commission, in his paper on "Water Supply as Effected by Regulation," pointed out the fact that although Chicago had spent more than $75,000,000 for the drainage canal, its water supply was still menaced by its neighbors to the south and north. Responsibility for the regulation of water supply and sewage pollution is now divided among four state agencies. The state water survey has advisory and investigating powers; the board of health requires the submission and approval of plans; the rivers and lakes commission intends to prevent all stream and lake pollution affecting fish life and the public utility commission has already ordered two private filter plants constructed to serve their customers adequately and safely. He would put all of this overlapping and conflicting authority under one head. Further, he advocated federal control over the states with reasonable penalties for the pollution of those streams over which the national government now has jurisdiction. After a national commission had made a scientific study, he held, it should have authority to compel the states to carry out water-supply and sewage-disposal measures, as the case might demand.

H. E. Barnard, Indiana state food and drug commissioner, in his paper on "Public Utilities and Public Health," was vigorous in his views of the necessity of making the waterworks officials recognize the importance of purveying only potable water. He deplored the fact that the fire chief's demands were too often more heeded than the admonitions of the health officer. Condemnation was heaped on waterworks officials of four towns in Indiana where the use of chemicals was stopped for periods of from two days to four weeks because of negligence in failing to order chemicals on time. Such officers who jeopardized human life would not long hold their commissions in an army. Reasons for this condition, he held, are that consumers are asleep, health officials are timid, the press is indifferent and chambers of commerce are afraid of hurting business.

Elected President of American Railway Engineering Association

J. G. SULLIVAN

Filter Lake Michigan Water

Eventual filtration of all the water taken from Lake Michigan was the prediction of S. A. Greeley in his paper on "The Treatment of Supplies from Lake Michigan." In the meantime, where reliance must be placed on treatment with chlorine, expert supervision should be provided and routine analyses made at frequent intervals. H. M. Ely, superintendent of the Interstate Water Company, Danville, indicated, by lantern slides showing his own company's improvements, the ever-increasing demands. The latest improvement is a timber trestle dam with a concrete armor facing over it. To prevent the 2 x 4-in. needles from swelling so tightly together that they cannot be removed, a strip of felt used in road expansion joints is applied at intervals of 16 ft.

The flow of water from different portions of the underground galleries of the Des Moines Water Company was determined by the continuous application of salt at the upper end, and then sampling the water at various manholes. D. H. Maxwell, assistant engineer with Alvord & Burdick, outlined the method, stating that it was used instead of current meters on account of the low velocities. The yield per foot length varied from 0.2 to 1.11 gal. per minute.

W. R. Gelston, superintendent of the Quincy waterworks, led the round-table discussion on the value and relation of laboratory control to the operation of water purification plants. His motto is: "Strive for the best efficiency consistent with safety first." He stated that 1½ hr. was necessary to collect samples, plate them, make the counts and record them. Five different samples of water are collected for plating, and duplicate agar plates are run on each sample twenty times per month.

The officers elected for the coming year are as follows: Chairman, E. MacDonald; vice-chairman, W. W. De Berard; treasurer, H. E. Keeler; new trustee, L. A. Fritze, and old trustees, F. C. Amsbary and W. E. Lautz. These compose the board of directors, and they elected Prof. Edward Bartow secretary.

J. G. Sullivan Heads Railway Engineering Association

J. G. Sullivan, chief engineer of the Western lines of the Canadian Pacific Railway, was elected president of the American Railway Engineering Association at its annual convention in Chicago this week. The awarding of the office to Canada emphasizes the absence of the international boundary line in this organization, and seems particularly happy at this time.

Although Mr. Sullivan has spent twenty years with Canadian railroads, he is not a native of Canada. He was born Jan. 11, 1863, at Bushnell's Basin in western New York, and was educated at Cornell University, being graduated in 1888. He entered railroad service the same year, starting with the Great Northern Railway as rodman. Part of 1889 and 1890 he was with the Spokane Falls Northern Railway, but returned to the Great Northern as assistant engineer, remaining until 1893. Two years with the Alberta Railway & Coal Company as assistant engineer, a short period with the Butte, Anaconda & Pacific Railway as locating engineer, and a year with Kaslo & Slocan as principal assistant engineer followed.

In 1896 he went to the Columbia & Western Railway, now a part of the

Canadian Pacific system, as reconnaissance engineer, and two years later became principal assistant engineer. In 1900 he was made division engineer of construction of the Canadian Pacific, holding this position until 1905. At that time he went to the Panama Canal as assistant chief engineer, but returned early in 1907 to become manager of construction of the Eastern lines of the Canadian Pacific. The next year he became assistant chief engineer, early in 1911 was assigned to the Western lines, and in October of the same year was advanced to the place he now holds.

Mr. Sullivan has been a member of the American Railway Engineering Association since 1900. He has served on the ballast and roadway committees and the committee on economics of railway location, and has been chairman of the latter committee for the last three years. He was elected a director of the society in 1913, second vice-president in 1915, and first vice-president a year later. He is also a member of the American Society of Civil Engineers and the Canadian Society of Civil Engineers.

To Hang Illinois Road Bond Issue on Auto Owners

The latest turn in the $60,000,000 good-roads bond issue in Illinois will hang the burden mainly on the automobile owners by doubling the state license fee within three years. At a meeting of the Illinois Highway Improvement Association at Springfield, Governor F. O. Lowden indicated that he would not support a proposition to raise the money by general taxation, but he would accept a proposal to increase the license fees 50 per cent in 1918 and 50 per cent in 1920. It is estimated that the revenue produced in twenty-five years, the life of the 20-year bonds, will be $145,000,000. This will take care of the interest and principal, and in addition leave $63,000,000 for the state-aid fund to help the counties which would be required to put up an equal amount. The state-road system consists of approximately 16,000 miles and, in round numbers, $200,000,000 will build the system.

The automobile associations, representing the 300,000 machines in the state, have already signified their willingness to co-operate, realizing that the yearly wear and tear on machines, due to present road conditions, is more than equal to the additional tax proposed. The proposition is to be put up to the present legislature, which can authorize an election on the bond issue in November, 1918.

New Jersey Road Board Named

The New Jersey Highway Commission of eight members was nominated last week by Governor Edge. The two engineers required by law to form a part of the board are Colonel Edwin A. Stevens, appointed for a two-year term, and Watson G. Clark, appointed for a three-year term.

All-Inclusive Engineers' License Bill Up in Iowa

After July 4 the practice of civil engineering in Iowa without a license will be a misdemeanor, carrying a fine of from $100 to $500, or a sentence of three months in jail, if a bill now in the hands of the Senate judiciary committee is enacted. As noted in the Engineering Record of March 3, page 365, in the report of the Iowa Engineering Society meeting, the bill provides for an examining board selected from a list furnished by the Iowa Engineering Society, a $3,000 secretary, classification into branches, a $10 examination fee to be renewed yearly for $1, a $3 fee for non-residents holding a license from their own State, and the exemption of services rendered to the U. S. Government, or to interstate carriers.

Smoke Ordinance Proposed for Denver

Proceeding on the assumption that smoke cannot be eliminated but can be materially reduced without harsh restrictions or unnecessary hardships, the committee of the Civic and Commercial Association of Denver recently submitted an ordinance to the city authorities which proposed a comprehensive system of smoke abatement for the city.

The present city ordinance dealing with smoke abatement, the committee finds, is defective and useless. In the administration of new regulations it is suggested that there be appointed a commission consisting of five members to act as an advisory body to the smoke inspector and, in a general way, to obtain the co-operation of the owners of all power or heating plants; also to establish rules for the guidance of the smoke inspector. No legal action is to be taken by the city without the sanction of this commission, which is to consist of three men actively engaged in engineering practice, one the owner or representative of substantial real-estate interests in the business district, and one an actual manufacturer. All are to serve without pay and for terms ranging from one to five years. It is proposed that the inspection department of the city shall include a deputy inspector appointed by the mayor, whose duty shall be to aid in the abatement and prevention of unnecessary smoke. Plans for new plants, or for the reconstruction of old plants producing power and heat, or for any new chimney connected therewith, must be presented for the approval of the smoke inspector.

The emission of smoke of a density in excess of 40 per cent, or equivalent to No. 2 of the Ringlemann scale of smoke densities, from any plant, locomotive or contrivance, is prohibited and declared to be a violation of the ordinance. An exception is made, allowing a period of 15 minutes in any one hour for cleaning fire boxes or building new fires.

It is required that all existing heating or power plants, in which 90,000 cu. ft. of air is heated by the same plant, shall register with the smoke inspector the name and address of the owner, together with size or manufacturer's rating of the boiler. Any person violating any of the provisions of the ordinance is liable to a fine of not more than $100 for each offense.

The committee consists of Frank E. Shepard, W. W. Case, Jr., C. S. Pearse, Henry Read, and Lewis C. Skinner.

Prize Winners in Housing Competition Announced

Prize winners in the national housing competition inaugurated by the National Americanization Committee in the spring of 1916 have been announced, and the prize-winning plans published in the January issue of *The Architectural Review.* The object of the competition was to produce good and economical plans for low-cost dwellings to be used as standard types, in this manner directing the attention of manufacturers, property owners and municipalities to the importance of industrial housing and providing definite solutions for particular housing problems.

The various classes in which prizes were awarded, and the prize winners, are as follows: First prize, four-room, single-family house design, by William Lyon Summerville and Atwell J. King, associated; second prize, five-room, single-family house design, by J. Theodore Hanemann; first prize, six-room, single-family house design, with two rooms arranged for four boarders, by William Lyon Summerville (Atwell J. King associated); second prize, by John Ambrose Thompson and Ernest F. Lewis; first prize, boarding-house design, by Harry E. Warren; second prize, by E. F. Strassle.

Copies of the prize-winning designs can be obtained from the National Americanization Committee, 29 West Thirty-ninth Street, New York City, or from *The Architectural Review,* 144 Congress Street, Boston.

Alumni of Stevens Tech Organize

During the past year the alumni of Stevens Institute of Technology have been compiling a classified list of Stevens men who are willing and ready to serve in such branches of the Army or Navy for which their education and experience would best fit them. The enrollment is being carried on under the auspices of an advisory committee, of which Alex C. Humphreys, president of Stevens Institute of Technology, is chairman.

Seattle, Wash., Rejects Bond Issues

Seattle, Wash., has rejected by an overwhelming majority all bond issues submitted March 6. The defeated issues provided for the following items: $270,000 for Montlake bridge over the Lake Washington government canal, $450,000 for highway improvement.

Southern Railway System Replaces Frame Trestles

To facilitate the movement of the very heavy traffic which passes over the line between Morristown, Tenn., and Salisbury, N. C., the Southern system plans to put in service Santa Fe type freight locomotives, which are much heavier than the ones now in use, and which make it necessary to replace every frame trestle on 228 miles of the line by permanent structures of steel and concrete. This work has been in progress for several months.

The extent of the work will be understood from the fact that it includes the erection of 18 new steel bridges to take the place of lighter structures, encasing 5 stone and brick arches in reinforced concrete, the elimination of 119 trestles by construction of 6 underpasses for highways and 14 concrete culverts, and the earth filling of the remaining trestle construction. Large concrete and cast-iron pipes will be placed to take care of drainage.

Over the section being remodeled a large volume of coal is handled from Virginia and Tennessee mines, and a heavy miscellaneous traffic in both directions. The section between Morristown and Asheville carries the heaviest traffic, and includes the recently inaugurated movement of Southern coal for export through the port of Charleston.

Southern Pacific Arranges for New Western Terminal

Following a meeting held recently in San Francisco between city officials and E. B. Leavitt, assistant general manager of the Southern Pacific Railroad, to arrange for the transfer of a site for a rail-and-water terminal, a resolution was adopted by the Board of Supervisors directing the city attorney to arrange for the transfer of city property in China Basin, which the railroad company desires for terminals, in exchange for property owned by the company at the foot of Van Ness Avenue. The city is also to receive from the company $392,073 in cash, which represents the difference between the appraised value of the two properties. The city lands to be transferred to the company were appraised at $818,768.

China Basin is an arm of San Francisco Bay, about 2 miles south of the foot of Market Street, located near the present Third and Townsend streets depot of the railroad company. By improving the channel in the basin and erecting suitable structures, industrial sites will be provided with rail and water connections for manufacturing establishments.

Idaho to Prohibit Narrow Tires

A bill recently passing the lower house of the Idaho legislature prohibits the sale of wagons having tires less than 3 in. in width, and makes it a misdemeanor to go outside the state to purchase such wagons. The act calls for enforcement after Jan. 1, 1919.

What Engineers and Contractors Are Doing

W. M. BUTTS has severed his connection as assistant division engineer of the Huntsville division of the Nashville, Chattanooga & St. Louis Railway, and has returned to the Pacific Coast.

CHRISTOPHER HARRISON, who has been city engineer of Everett, Mass., for the last twenty years, has resigned and will become city engineer of Montclair, N. J., on April 1.

HOWARD F. WEISS has resigned his position as director of the U. S. Forest Products Laboratory, Madison, Wis., to engage in the development of products and processes for the profitable utilization of wood and timber with the C. F. Burgess Chemical Engineering Laboratories, Madison. As director of the U. S. Forest Products Laboratory, Mr. Weiss, while devoting his time to the study of wood, had charge of numerous investigations in kiln drying, wood preservation, wood distillation, pulp and paper manufacture, mechanical testing of timber, production of ethyl alcohol, turpentine and other wood products in the United States, Canada, Cuba and South America. He is a graduate of both Yale and Cornell universities, and entered the forest service twelve years ago. He is author of the book, "Preservation of Structural Timber."

H. C. CORNS and C. C. THOMAS have formed the Corns-Thomas Engineering & Contracting Company, Inc., with offices in the First National Bank Building, Huntington, W. Va. Mr. Corns has had twenty years' experience on river and harbor, municipal and private work. Until recently Mr. Thomas was manager of the Wetzel Engineering Company.

J. M. WEIR has been appointed chief engineer by the Kansas City Southern Railway, with headquarters in Kansas City, Mo. Mr. Weir entered the employ of the railroad in June, 1916, as division engineer.

J. MONROE JOHNSON, of Marion, S. C., has been appointed a member of the State Highway Commission created recently by the general assembly. Mr. Johnson has been connected with the state reclamation and drainage work. He organized the Johnson Engineers' Corps of the South Carolina National Guard.

P. W. LOONAM, county surveyor, St. Charles County, Missouri, has been appointed county highway engineer to succeed Alfred Riske.

HARLEY O. MARQUIS, Monon, Ind., has been appointed chief engineer of the city water works, succeeding John G. Hill.

JOHN C. HITESHEW, Carlisle, Pa., has been appointed borough engineer at Waynesboro, succeeding George C. Brehm, resigned.

H. Y. SMITH, for the last ten years with the Atlantic Construction & Supply Company, Atlantic City, N. J., is now associated with the Wisconsin Tunnel & Construction Company, Milwaukee, Wis., as its engineer-superintendent in charge of sewer tunnels and open-cut work in Milwaukee, estimated to cost $700,000.

J. C. HOLLAND, for several years designer and estimator for the Illinois Steel Company, warehouse department, is engaged as chief draftsman for the St. Joseph Structural Steel Company at St. Joseph, Mo. Mr. Holland is a graduate of the University of Minnesota, 1904, and has been located in the Chicago district since 1905.

STANLEY E. BATES, formerly editor and manager of *The Contractor*, has become associated with the Lee Loader & Body Company, South La Salle Street, Chicago. Mr. Bates has made a special study of haulage problems, particularly those of the contractor, and is author of many articles on the subject. His new duties will be in charge of the sales department.

A. L. STRONG, until last February county engineer of Skagit County, at Mount Vernon, Wash., has joined the forces of the Skagit Valley Construction Company of that city.

CHARLES W. MARTIN, engineer, of St. Louis, Mo., has become a member of the Woermann Construction Company of that city. Mr. Martin has been a member of the bridge department of St. Louis for the last seven years.

J. A. MACKALL, Baltimore, Md., has been appointed an assistant to the chief engineer of the Pennsylvania State Highway Department.

EVERETT L. JONES, for six years chief engineer for Booth & Flinn, Ltd., general contractors, of Pittsburgh, Pa., has resigned to become general superintendent and chief engineer of the Pittsburgh-Hanover Coal Company, with offices in the Vandergrift Building.

S. CAMDEN MILLER has accepted the position of general manager with the Mesker Brothers Iron Company, of St. Louis, Mo. Mr. Miller was formerly operating engineer of the Canton Bridge Company, of Canton, Ohio.

A. H. JONES has been appointed assistant engineer on street-railway matters, Bureau of Engineering, by the Public Service Commission of Harrisburg, Pa. For the last seven years Mr. Jones has been with the Public Service Railway of Newark, N. J., under the engineer of maintenance of way, in the capacity of engineer, roadmaster and division engineer.

L. H. NISHKIAN has been reappointed structural engineer of the building-permit department of the city of San Francisco. Political reasons were ascribed for Mr. Nishkian's removal from this office last year, at which time the San Francisco Association of Members of the American Society of Civil Engineers adopted a resolution regretting his removal and expressing "confidence in the impartial, trustworthy, fearless and competent manner in which he has conducted work in his office." The reappointment came after Mr. Nishkian passed a competitive examination for the office.

CARL H. REEVES, consulting civil engineer, Seattle, secretary-treasurer of the Seattle Association of Members of the American Society of Civil Engineers; John L. Hall, consulting engineer, president of the Associated Engineering Societies of Seattle, and Amos Slater, mining engineer, acting secretary-treasurer of the Associated Engineering Societies of Seattle, have become associated in business and will hereafter have their offices at 445-46 Henry Building.

WILLIAM H. CORDDRY, formerly with the W. J. Sherman Company, Toledo, Ohio, on dam construction, and at one time assistant engineer, Baltimore Sewerage Commission, has joined the staff of Gannett, Seelye & Fleming as assistant engineer in connection with the Mill Creek flood control and Erie sewage-treatment investigation. He is a graduate of Lehigh University, class of 1911.

C. A. JENNINGS has been put in charge of the new Chicago office opened by the Wallace & Tiernan Company, Inc., manufacturers of chlorine-control apparatus. Mr. Jennings was formerly engaged on work in connection with the Bubbly Creek filters of the Union Stock Yards in Chicago, and has done considerable research in the field of water purification, particularly along the lines of chlorination. H. K. Davies will be transferred from the New York office of the company to Chicago as assistant engineer to Mr. Jennings. J. C. Kaebler has been appointed to the technical staff of the company as assistant engineer. He is a graduate of the University of Rochester and was formerly connected with the Western Electric Company. R. V. Donnelly has been made assistant sanitary engineer. Mr. Donnelly is a graduate of Columbia University and was for a time with the New York Continental Jewell Filtration Company.

ALBERT R. BAILEY, assistant professor of civil engineering, University of Michigan, has been granted a leave of absence for the remainder of the college year to accept a position with F. W. Stevens, general valuation counsel for the New York City Railroad. He will be located in New York City after March 19.

ROYALL D. BRADBURY, consulting engineer, Boston, Mass, has closed his office and has become manager of the newly created structural department of the Clinton Wire Cloth Company, Boston, Mass. Mr. Bradbury has for about eight years been acting as consulting engineer of the Clinton Wire Cloth Company, meanwhile carrying on a general consulting engineering practice, chiefly in structural lines. He was for seven years a member of the instructional staff of the Massachusetts Institute of Technology, teaching courses in bridge design, theory of structures and reinforced concrete. As consulting engineer for the Clinton Wire Cloth Company he has advised on tests of new products and types of construction, has directed extensive investigations and, in general, assisted the company in perfecting its structural products.

RAYMOND DU PUY, who has resigned as president of the Virginian Railway, with headquarters at Norfolk, Va., was assistant engineer on the Missouri, Kansas & Texas Lines from 1878 to 1881, and was chief engineer and superintendent of the Tioga Railway, now a part of the Erie Railroad, from 1881 to 1885.

W. K. WALKER, assistant engineer on the Wabash Railroad at Fort Wayne, Ind., has been appointed engineer maintenance of way, with headquarters at Montpelier, Ohio.

THOMAS BERNARD, assistant to the chief engineer, maintenance of way and structures, of the Southern Railway, with headquarters at Greensboro, N. C., has been appointed engineer of surveys, with headquarters at Washington, D. C. He has been in the continuous employ of this road since 1882, since which time he has served as assistant engineer, roadmaster, superintendent of tracks, bridges and buildings, engineer maintenance of way and assistant to the chief engineer maintenance of way and structures.

WENDELL P. BALL, assistant engineer of track construction on the Cincinnati, Hamilton & Dayton Railway, has been appointed to the newly created position of district bridge inspector.

PAUL B. LUM, assistant engineer of the Southern Railway at Washington, D. C., has been appointed to the newly created position of structural engineer, where he is in charge of structural work in the office of T. H. Gatlin, assistant to the vice-president at Washington, D. C. Mr. Lum entered railway service with the Lake Shore & Michigan Southern Railway, and subsequently was employed by the American Bridge Company at its Pencoyd plant. He entered the employ of the Southern Railway as an assistant engineer in 1908.

M. J. CONNERTON, roadmaster of the Queen & Crescent Route at Danville, Ky., has been appointed engineer maintenance of way of the southwest district of the Southern Railway, lines West, with headquarters at Chattanooga, Tenn.

M. P. NORTHAM, office engineer of the Southern Railway at Washington, D. C., has been appointed supervising engineer, with headquarters at the same point.

O. L. VANDAMENT, assistant division engineer of the Louisville & Nashville Railway, with headquarters at Louisville, Ky., has been transferred to the office of the chief engineer, succeeding J. C. Haskins, who has resigned to go with the Roberts & Schaefer Company, Chicago. J. E. Scott, assistant division engineer, with headquarters at Montgomery, Ala., has been transferred to Louisville, to succeed Mr. Vandament.

S. A. JUBB, engineer in charge of the harbor work at Los Angeles, Cal., has been authorized by the harbor commission of that city to go to Washington, D. C., in the interests of extensions of Los Angeles harbor facilities. Mr. Jubb is instructed to take up with government officials plans for a submarine base in the outer harbor, the question of widening the harbor's main channel to 1000 ft. and of having a survey made of the west basin relative to needed dredging.

H. S. SLOCUM, who has lately been engaged on the Laurentide hydroelectric development at Grand Mere, Province of Quebec, Canada, has entered the engineering department of the Aluminum Company of America, as engineer in charge of construction, and will be located at Potsdam, N. Y. Mr. Slocum has had extensive experience in the design and construction of hydroelectric plants. For six years he was with the Niagara Falls Power Company, and then went with Viele, Blackwell & Buck, working on the Great Western and the Appalachian power developments. Terminating his connection with Viele, Blackwell & Buck, he became mechanical engineer for the Cedar Rapids plant of the Cedar Rapids Manufacturing & Power Company, and then was engineer in charge for the Northern New York Power Corporation. From there he went to Grand Mere.

Civil Service Examinations

United States.—Structural-steel draftsman, Bureau of Yards and Docks, Navy Department, $3.04 to $8 per diem. Applications will be received at any time, owing to unusual conditions, and papers will be rated immediately upon their receipt. Apply to U. S. Civil Service Commission, Washington, D. C., for form No. 1312, or to any local office of the commission. Assistant inspector of engineering material, April 18, $4 to $4.48 per diem; apply at once for form No. 1312. Senior land appraiser, April 18, $1,800 to $2,700 per year; apply at once for form No. 1312.

California.—Engineering draftsman, Grade I and Grade II, April 6 and 7, $50 to $100, and $100 to $150 per month; apply to California Civil Service Commission, Forum Building, Sacramento, for form No. 2, and file before March 31. Civil engineer, April 13 and 14, $100 to $150; apply as above, and file before April 7. Engineering assistant, April 7, $50 to $100; apply as above and file before March 31.

Illinois.—Transportation rate expert, April 7, $416.66 to $500 per month; applicant must be over 26 years old; apply to Illinois Civil Service Commission, Springfield, Ill., for blank, and file before March 31.

Obituary Notes

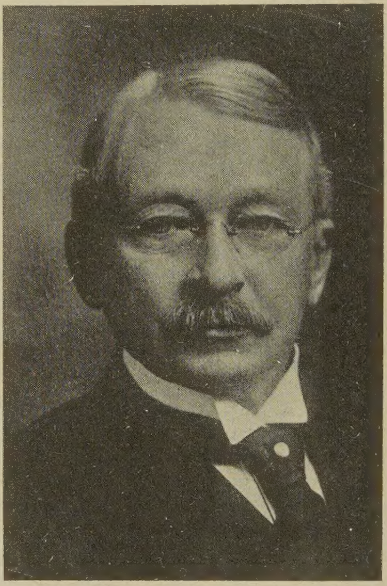
ALFRED W. PARKER, one of the best known structural steel inspecting engineers in New England, died recently at his home in Waltham, Mass., in his seventy-third year. He was a native of Providence, R. I., and after receiving a public school education was employed from 1863 to 1868 by J. R. Robinson & Company, Boston, contractors of steam plants in New England mills. From 1868 to 1876 he was superintendent of shops, National Bridge & Iron Works, Boston, and in 1877 was associated with Captain J. B. Eads in laying out and building a steel dredge boat at Pittsburgh, Pa. Following this work he superintended the steel erection on the Ninth and Second Avenue elevated lines in New York City for Clark, Reeves & Company, Phoenixville, Pa. From 1880 to 1895 Mr. Parker was with the Boston Bridge Works, and from 1895 to 1899 he was chief inspector of steel work for the Boston Transit Commission. He then spent four years as chief inspector of steel work for the Boston Elevated Railway, and from 1902 until his death was superintendent of steel work for the Boston Transit Commission.

GEORGE H. FROST, seventy-nine years old, founder and for many years publisher of the *Engineering News*, died March 15 at Plainfield, N. J. He was born in Ontario, and in 1860 was graduated from McGill University as civil engineer. He engaged in land surveying, and for several years was connected with the Chicago & Northwestern Railroad, laying the first mile of track west of Chicago. He founded the *Engineering News* in 1874, and published it until 1911. He was president of the Courier News Publishing Company of Plainfield, N. J., and a member of the American and Canadian societies of civil engineers and honorary member of engineering societies in several States.

PETER SIEMS of St. Paul, Minn., pioneer transportation and railway contractor, builder of the portion of the Great Northern Railway extending from Devils Lake, N. D., to the Pacific Coast, associate of the late James J. Hill, died at Daytona, Fla., March 3. Born in Germany in 1842, he came to the United States in 1865 and moved to St. Paul in 1870. His first transportation contract was carrying the mails overland from Fargo to Bismarck, Dakota Territory, in 1875. In 1884, after several years in stage operation and highway location in the gold country, he returned to St. Paul and entered the railway contracting business as a partner in D. C. Shepard & Company. Later, as Shepard, Siems & Co., the firm built many thousands of miles of railroad in the Northwest, including the Great Northern line to the Pacific in 1893. In 1889 the firm became Siems & Shields, and in 1908 it was reorganized as Siems & Co. Meanwhile Mr. Siems withdrew from active participation in the business, and six years ago, through affiliation with F. W. Carey, the concern again was reorganized and became the Siems-Carey Company. The Siems-Carey Company recently obtained a $100,000,000 contract for railway construction in China.

FERDINAND W. ROEBLING, treasurer and general manager of J. A. Roebling's Sons & Co., builders of the Brooklyn Bridge and other noted bridges, widely known in the wire rope industry, and director in a dozen or more other big companies, died March 16 at his home in Trenton, N. J. Mr. Roebling, who was seventy-five years old and the son of John A. Roebling, founder of the noted construction firm, was born in Saxonburg, Pa. He was educated in Polytechnic College, Philadelphia, and after graduation entered into business with his father. In 1869 his father was fatally injured in an accident while making soundings for the foundation of the Brooklyn Bridge, which he designed. The interrupted work of the father was taken up and finished in 1883 at a cost of $10,000,000 by Washington A. Roebling, the older son, and by Ferdinand. Mr. Roebling was a director in many concerns, among them the Interstate Railways Company, the Otis Elevator Company, the Public Service Corporation of New Jersey and the Trenton Street Railway Company. He was president of the Trenton Brass & Machine Company and the Union Mills Paper Manufacturing Company. He was a member of the Union League and Engineers' Club.

Head of Wire Rope Company Dies



FERDINAND W. ROEBLING

MAJOR CASSIUS E. GILLETTE, consulting engineer, prominent as an investigator, in which capacity he disclosed fraud on jetty work at Savannah, Ga., died March 18 at his home in Philadelphia. Major Gillette's most recent activity was investigating mines in Colorado. The illness which resulted in his death became serious while he was in Colorado, and he was forced to return home. He was born in Tonawanda, N. Y., in 1859, and after receiving a common school education in Tioga County received an appointment to West Point, from which he was graduated in 1884. He was assigned to the Engineer Corps, U. S. Army, and his service included a station in Ohio for five years on lock and canal work, a year in Savannah, Ga., four years in California and six months in Newport. He also saw service on the Isthmus of Panama and later went to Philadelphia as chairman of the commission of expert engineers which investigated work in connection with the filtration plant and boulevards. It was not long before he was offered the position of chief of the Bureau of Filtration at Philadelphia. In order to accept the position it was necessary for him to resign from the army. He resigned from the filtration bureau after the filter plant was completed and entered private practice.

DANIEL WHEELER BOWMAN, consulting engineer for the Phoenix Iron Company, Phoenixville, Pa., died March 13. He was born in New Bedford, Mass., in 1844 and was a graduate of Cornell University. His first work was with Captain James B. Eads on the control work at the mouth of the Mississippi River, directly under Elmer L. Corthell, late president of the American Society of Civil Engineers. In 1876 he became connected with Clark, Reeves & Co., now the Phoenix Bridge Company, and was engaged on the design of important structures then contemplated in New York City. He resigned from that position in 1885 to go to Florida on the inspection of bridges for the Southern Railway System. For a short time he was connected with the Boston Bridge Works, but in 1894 returned to the engineering office of the Phoenix Iron Company. About 1896 Mr. Bowman resigned from the Phoenix Iron Company, and engaged in structural fabrication in Chicago. He again returned to the Phoenix Iron Company in 1898, under H. H. Quimby, chief engineer, whom he succeeded in 1900. In 1914 he resigned his position, and was made consulting engineer.

R. J. GILLESPIE, vice-president of the T. A. Gillespie Company, contractor, of New York and Pittsburgh, died March 20 of pneumonia at his home in Pittsburgh. Mr. Gillespie had been in the continuous service of the company for about twenty-five years and acted as construction superintendent on many important contracts, among them a hydroelectric plant at Whitney, N. C., the Rondout siphon tunnel of the Catskill Aqueduct and the deep pressure tunnel of the Catskill Aqueduct crossing the Hudson River at Cornwall, N. Y. For the last two years Mr. Gillespie had been stationed in the vicinity of Pittsburgh on miscellaneous contracts of the company.